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Tanimoto et al.

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(54) **COMMUNICATION SYSTEM AND REMOTE DIAGNOSIS SYSTEM**

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(30) **Foreign Application Priority Data**

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Jun. 6, 2006 (JP) 2006-157332

(51) **Int. Cl.**
H04J 1/16 (2006.01)
H04L 12/56 (2006.01)

(52) **U.S. Cl.** **370/241**; 370/389; 370/401; 370/466

(58) **Field of Classification Search** 370/389, 370/401, 241, 466
See application file for complete search history.

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Primary Examiner—John Pezzlo
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(57) **ABSTRACT**

An object of the present invention is to provide a technique capable of promptly and efficiently starting a communication processing when a demand is generated, in a communication system including a terminal for a non-continuous connection. A communication terminal and a device can be connected through a relay device, and when the communication terminal transmits a UDP packet to the device, the relay device receives the UDP packet and transmits a control signal to the device. The device makes a dial-up connection to establish a PPP session, and establishes a TCP connection with the relay device. By using this TCP connection, the communication terminal transmits an inspection instruction file to the device. The device conducts an inspection in accordance with the inspection instruction file, prepares an inspection result file, and returns it to the communication terminal. Then, the device disconnects the TCP connection, the PPP session, and the dial-up line network.

9 Claims, 14 Drawing Sheets

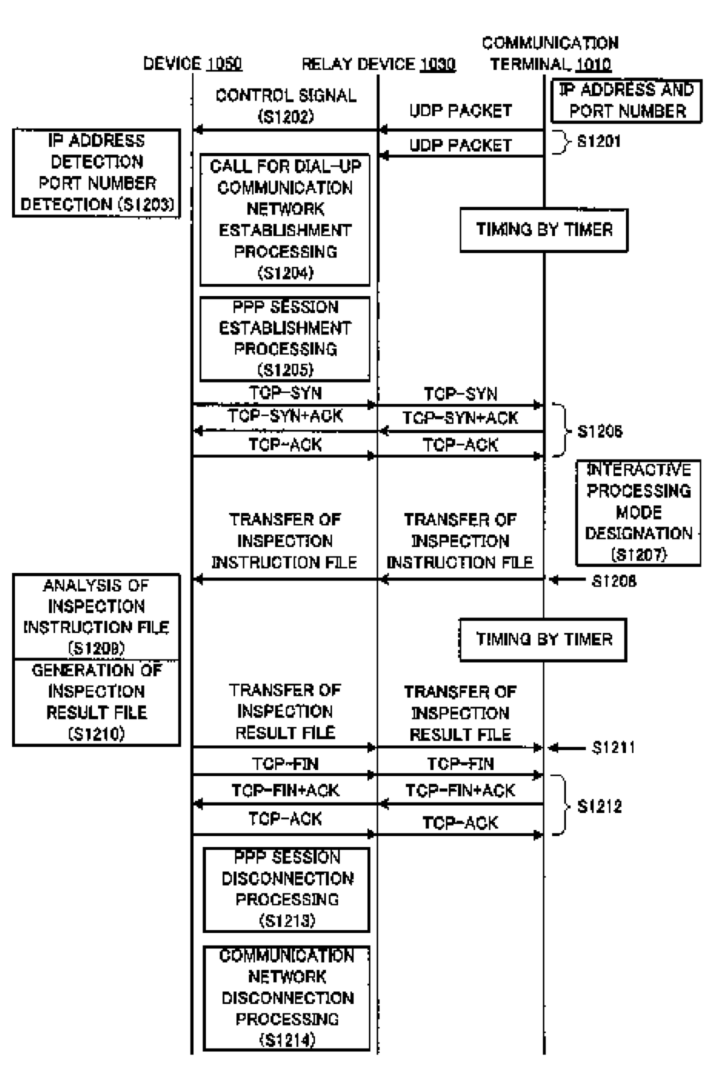

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FIG. 1

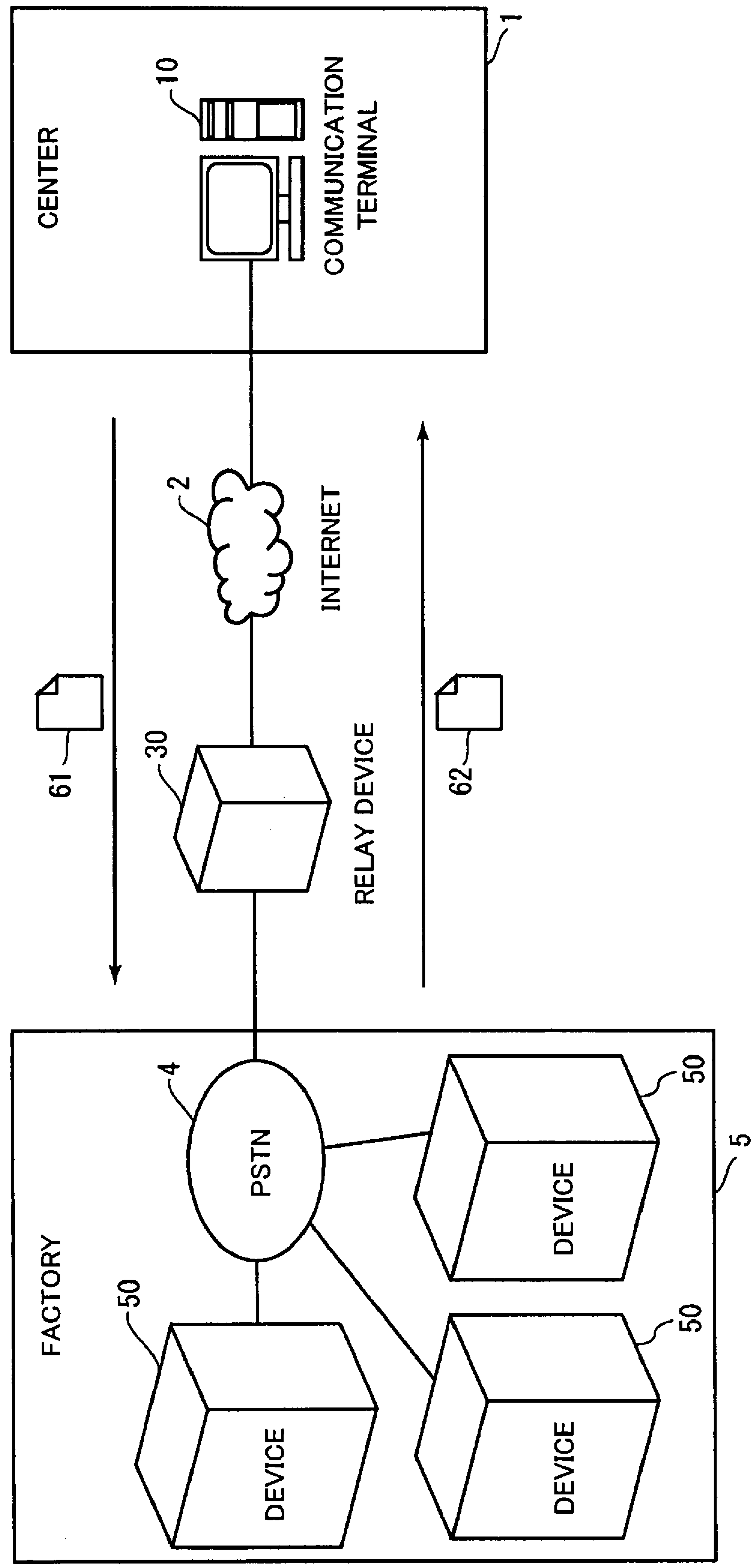
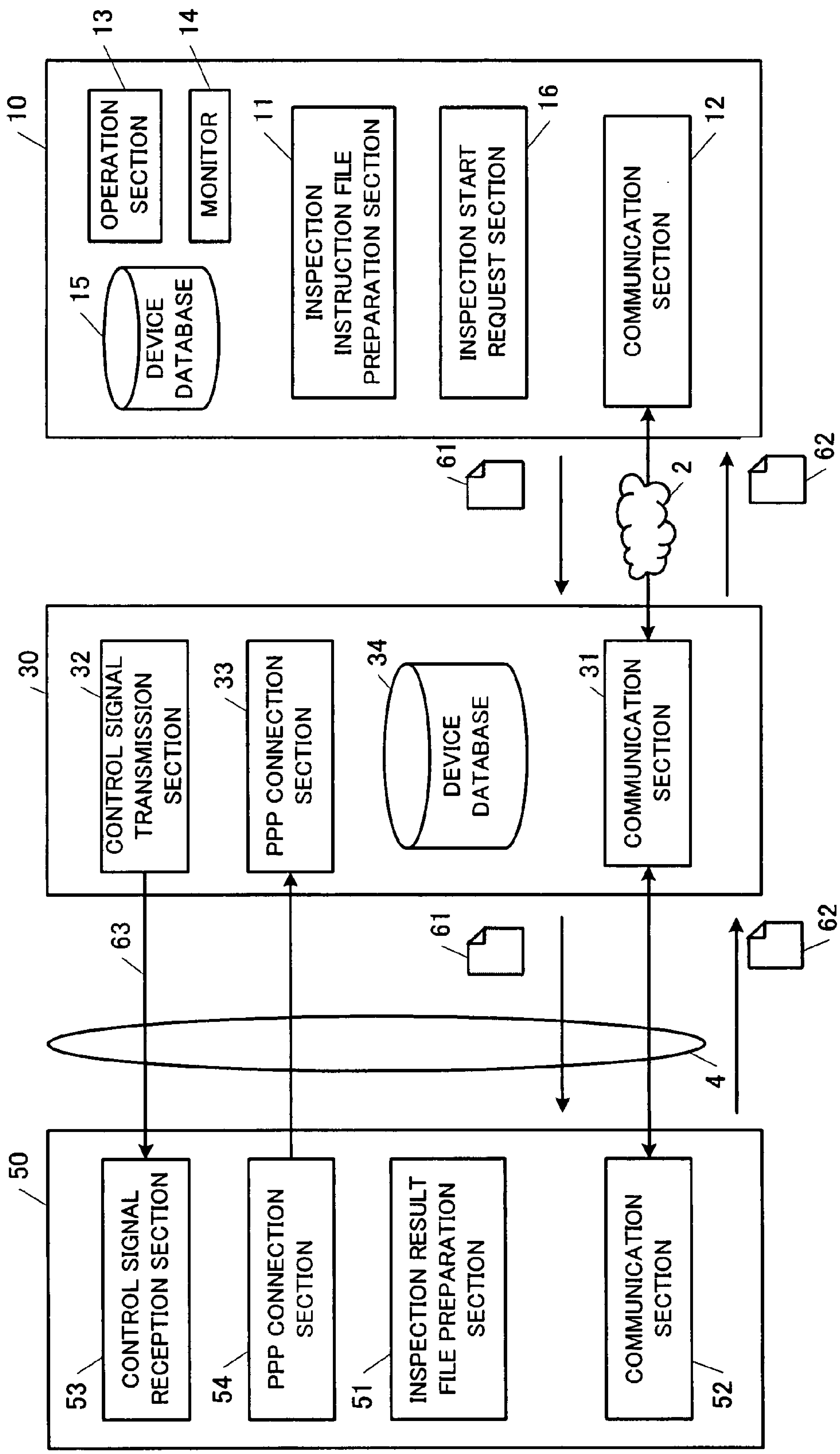

CENTER
10
1
COMMUNICATION TERMINAL
2
INTERNET
61
30
RELAY DEVICE
62
FACTORY
4
PSTN
50
DEVICE
5
50
DEVICE
50
DEVICE

FIG. 2



10
OPERATION SECTION
13
MONITOR
14
DEVICE DATABASE
15
INSPECTION INSTRUCTION FILE PREPARATION SECTION
11
INSPECTION START REQUEST SECTION
16
COMMUNICATION SECTION
12
61
2
62
30
CONTROL SIGNAL TRANSMISSION SECTION
32
PPP CONNECTION SECTION
33
DEVICE DATABASE
34
COMMUNICATION SECTION
31
63
61
62
4
50
CONTROL SIGNAL RECEPTION SECTION
53
PPP CONNECTION SECTION
54
INSPECTION RESULT FILE PREPARATION SECTION
51
COMMUNICATION SECTION
52

FIG. 3

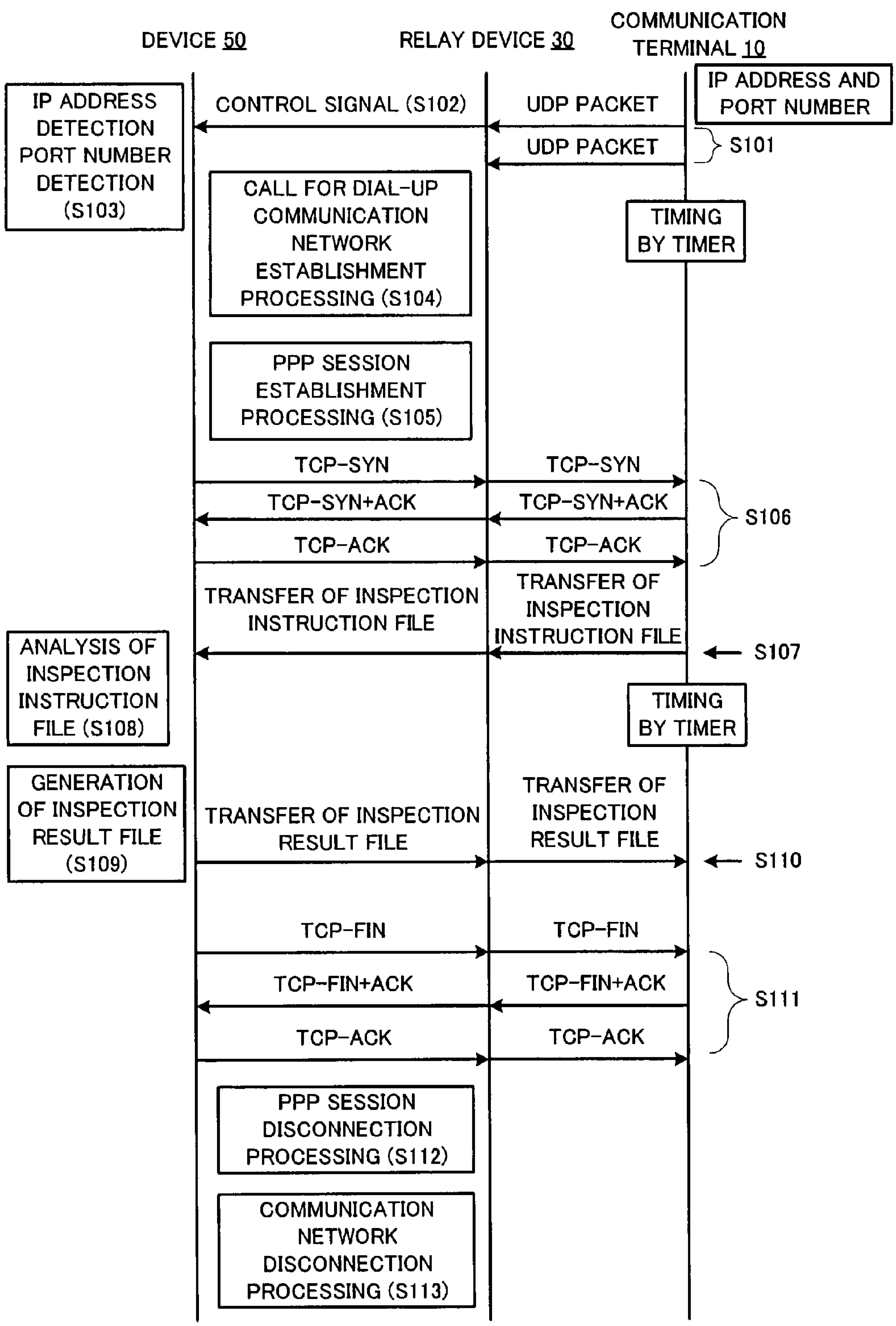

DEVICE 50
RELAY DEVICE 30
COMMUNICATION TERMINAL 10
IP ADDRESS AND PORT NUMBER
IP ADDRESS DETECTION PORT NUMBER DETECTION (S103)
CONTROL SIGNAL (S102)
UDP PACKET
UDP PACKET
S101
CALL FOR DIAL-UP COMMUNICATION NETWORK ESTABLISHMENT PROCESSING (S104)
TIMING BY TIMER
PPP SESSION ESTABLISHMENT PROCESSING (S105)
TCP-SYN
TCP-SYN
TCP-SYN+ACK
TCP-SYN+ACK
TCP-ACK
TCP-ACK
S106
TRANSFER OF INSPECTION INSTRUCTION FILE
TRANSFER OF INSPECTION INSTRUCTION FILE
S107
ANALYSIS OF INSPECTION INSTRUCTION FILE (S108)
TIMING BY TIMER
GENERATION OF INSPECTION RESULT FILE (S109)
TRANSFER OF INSPECTION RESULT FILE
TRANSFER OF INSPECTION RESULT FILE
S110
TCP-FIN
TCP-FIN
TCP-FIN+ACK
TCP-FIN+ACK
TCP-ACK
TCP-ACK
S111
PPP SESSION DISCONNECTION PROCESSING (S112)
COMMUNICATION NETWORK DISCONNECTION PROCESSING (S113)

FIG. 4

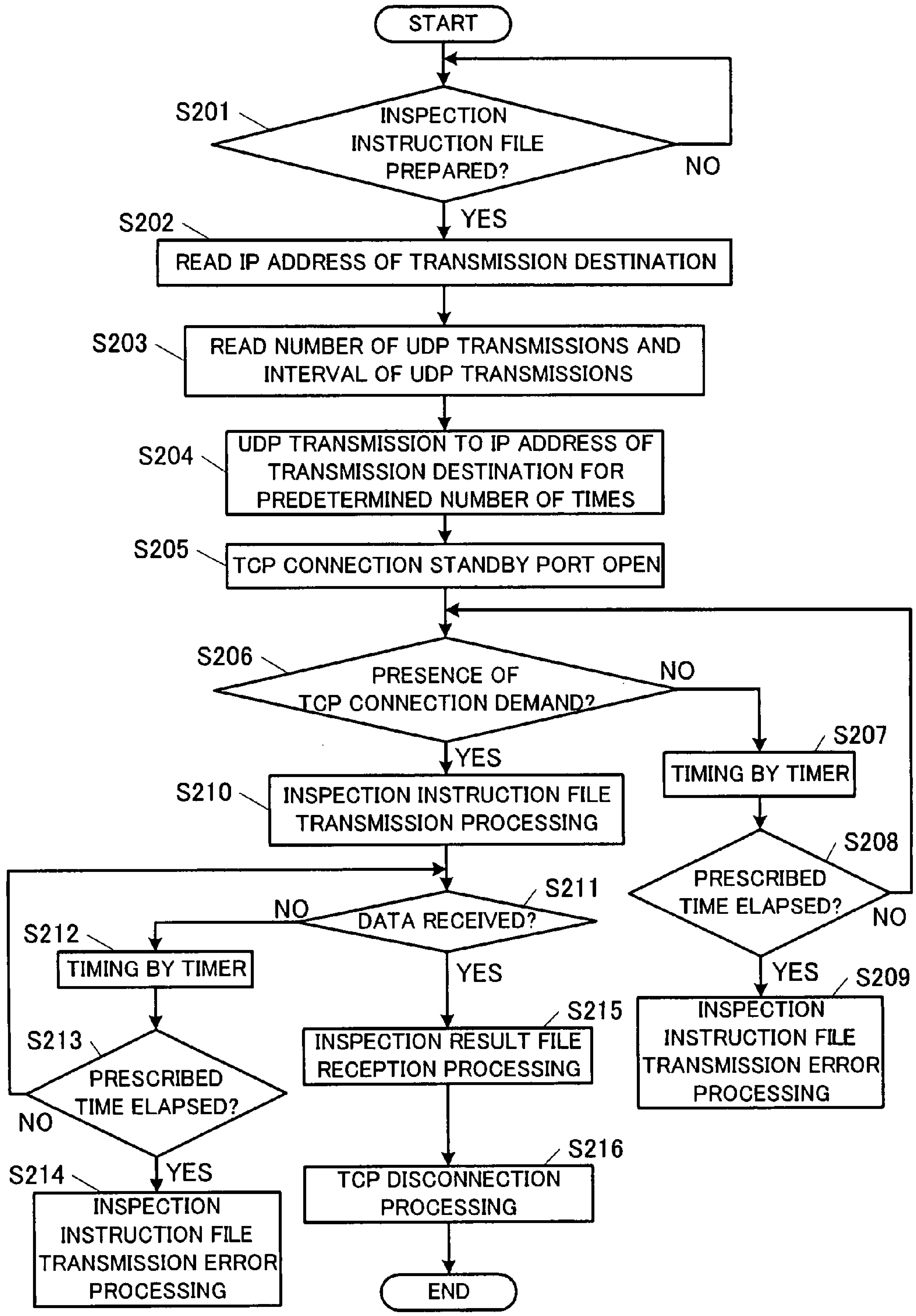

START
S201
INSPECTION INSTRUCTION FILE PREPARED?
NO
YES
S202
READ IP ADDRESS OF TRANSMISSION DESTINATION
S203
READ NUMBER OF UDP TRANSMISSIONS AND INTERVAL OF UDP TRANSMISSIONS
S204
UDP TRANSMISSION TO IP ADDRESS OF TRANSMISSION DESTINATION FOR PREDETERMINED NUMBER OF TIMES
S205
TCP CONNECTION STANDBY PORT OPEN
S206
PRESENCE OF TCP CONNECTION DEMAND?
NO
YES
S207
TIMING BY TIMER
S208
PRESCRIBED TIME ELAPSED?
NO
YES
S209
INSPECTION INSTRUCTION FILE TRANSMISSION ERROR PROCESSING
S210
INSPECTION INSTRUCTION FILE TRANSMISSION PROCESSING
S211
DATA RECEIVED?
NO
YES
S212
TIMING BY TIMER
S213
PRESCRIBED TIME ELAPSED?
NO
YES
S214
INSPECTION INSTRUCTION FILE TRANSMISSION ERROR PROCESSING
S215
INSPECTION RESULT FILE RECEPTION PROCESSING
S216
TCP DISCONNECTION PROCESSING
END

FIG. 5

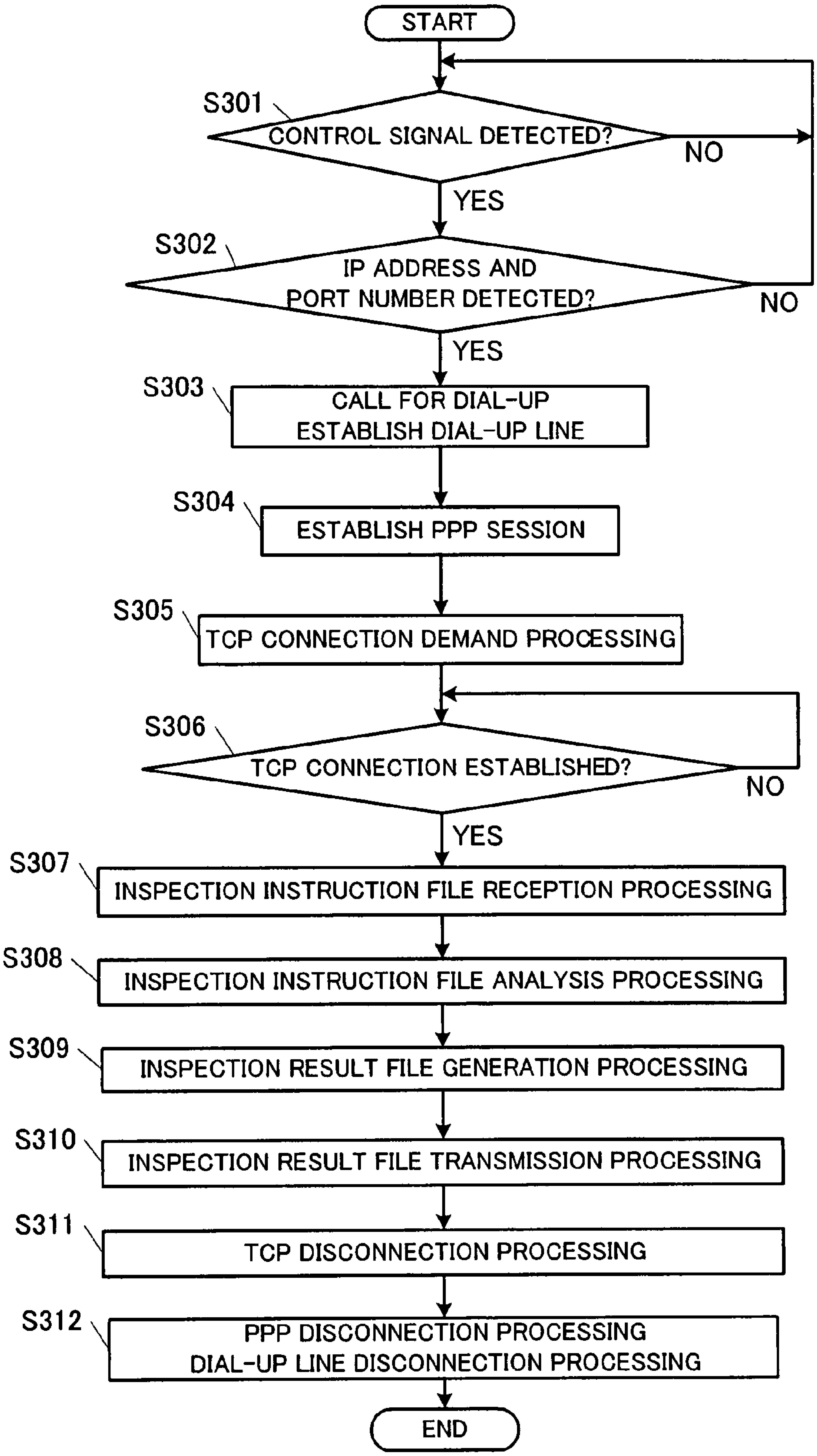

START
S301
CONTROL SIGNAL DETECTED?
NO
YES
S302
IP ADDRESS AND PORT NUMBER DETECTED?
NO
YES
S303
CALL FOR DIAL-UP ESTABLISH DIAL-UP LINE
S304
ESTABLISH PPP SESSION
S305
TCP CONNECTION DEMAND PROCESSING
S306
TCP CONNECTION ESTABLISHED?
NO
YES
S307
INSPECTION INSTRUCTION FILE RECEPTION PROCESSING
S308
INSPECTION INSTRUCTION FILE ANALYSIS PROCESSING
S309
INSPECTION RESULT FILE GENERATION PROCESSING
S310
INSPECTION RESULT FILE TRANSMISSION PROCESSING
S311
TCP DISCONNECTION PROCESSING
S312
PPP DISCONNECTION PROCESSING DIAL-UP LINE DISCONNECTION PROCESSING
END

FIG. 6

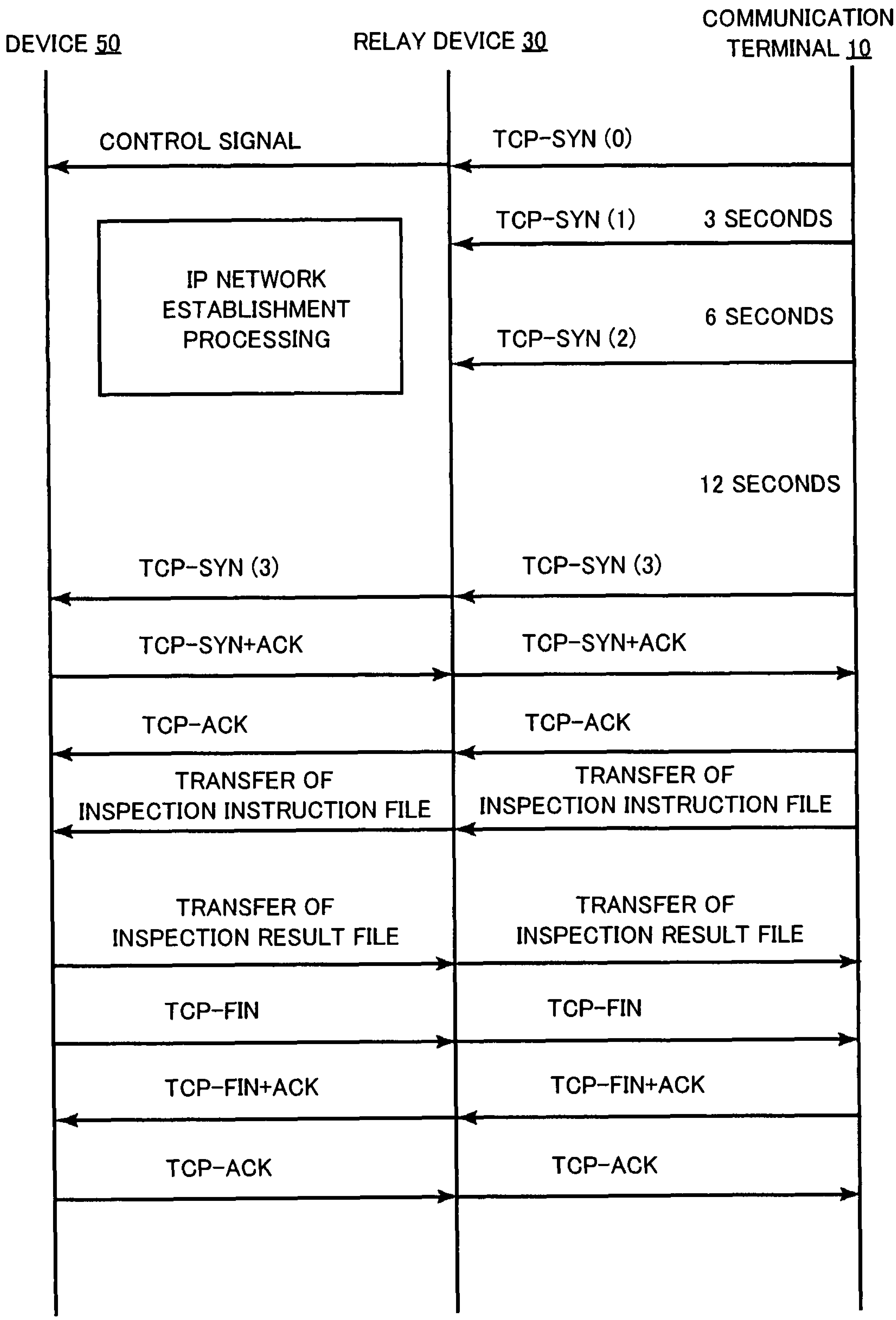

DEVICE 50
RELAY DEVICE 30
COMMUNICATION TERMINAL 10
CONTROL SIGNAL
TCP-SYN (0)
TCP-SYN (1)
3 SECONDS
IP NETWORK ESTABLISHMENT PROCESSING
6 SECONDS
TCP-SYN (2)
12 SECONDS
TCP-SYN (3)
TCP-SYN (3)
TCP-SYN+ACK
TCP-SYN+ACK
TCP-ACK
TCP-ACK
TRANSFER OF INSPECTION INSTRUCTION FILE
TRANSFER OF INSPECTION INSTRUCTION FILE
TRANSFER OF INSPECTION RESULT FILE
TRANSFER OF INSPECTION RESULT FILE
TCP-FIN
TCP-FIN
TCP-FIN+ACK
TCP-FIN+ACK
TCP-ACK
TCP-ACK

FIG. 7

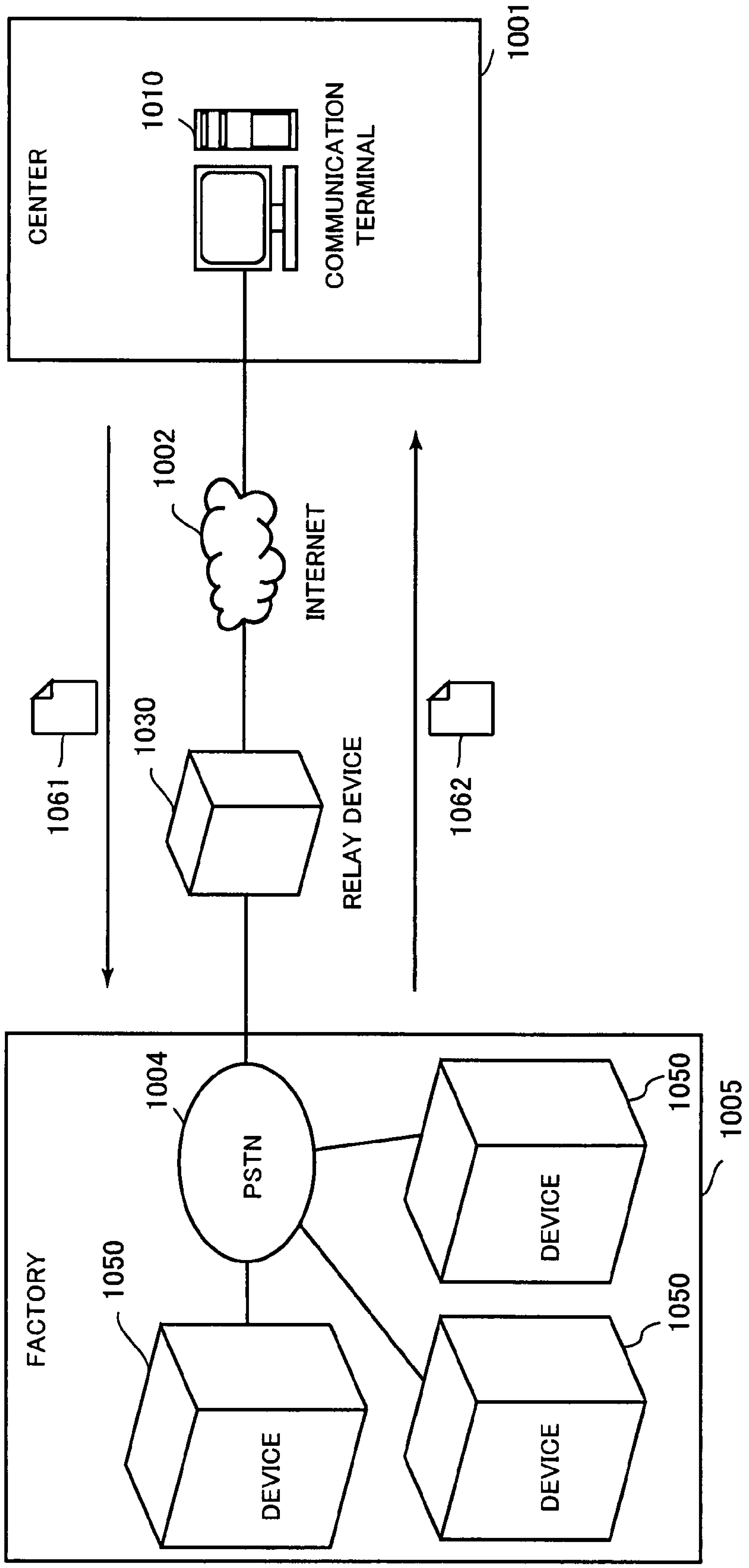

CENTER
1001
1010
COMMUNICATION TERMINAL
1002
INTERNET
1061
1030
RELAY DEVICE
1062
FACTORY
1004
PSTN
1005
1050
DEVICE
1050
DEVICE
1050
DEVICE

FIG. 8

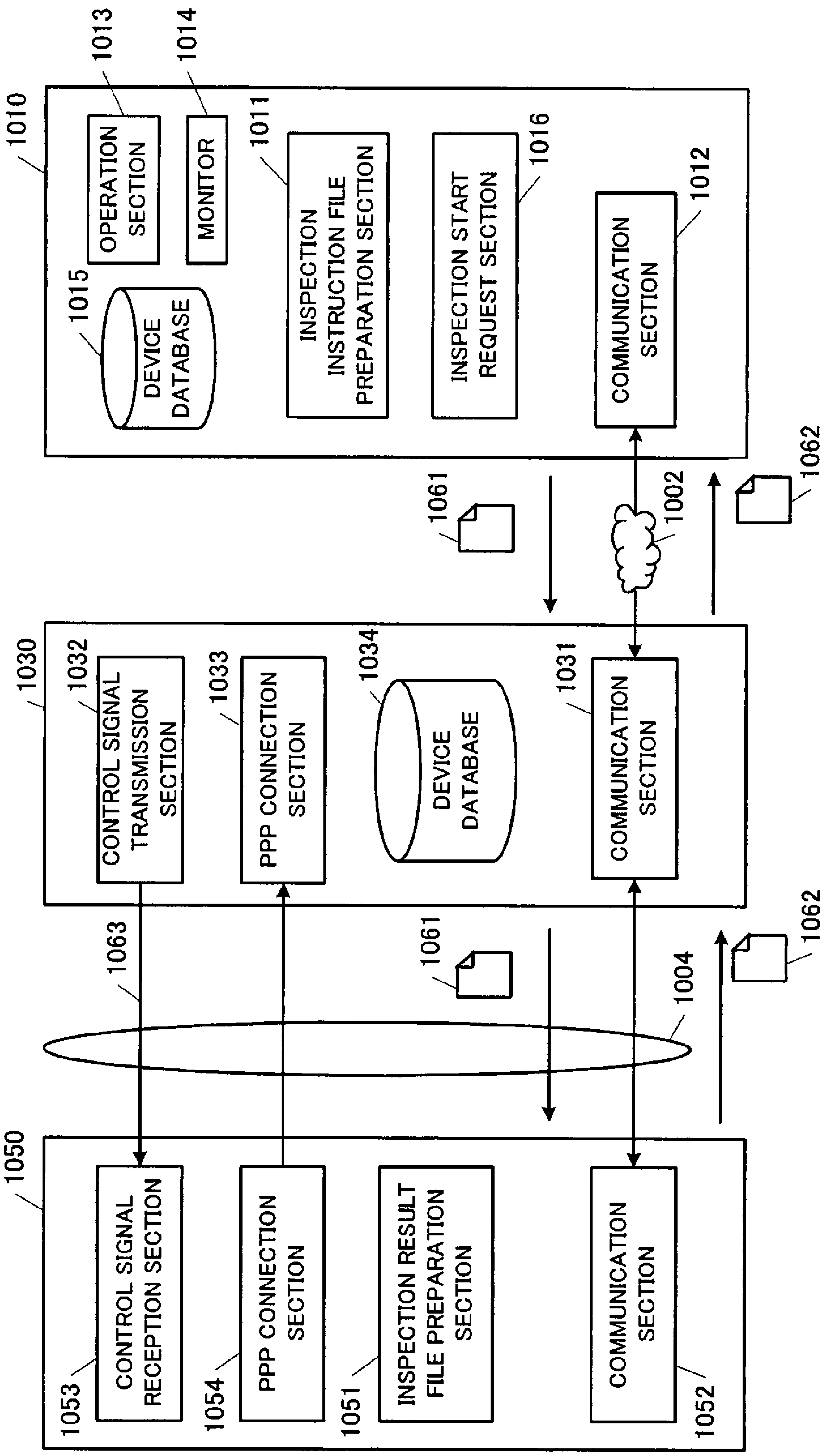

1010
1013
1014
OPERATION SECTION
MONITOR
1015
DEVICE DATABASE
1011
INSPECTION INSTRUCTION FILE PREPARATION SECTION
1016
INSPECTION START REQUEST SECTION
1012
COMMUNICATION SECTION
1061
1002
1062
1030
1032
CONTROL SIGNAL TRANSMISSION SECTION
1033
PPP CONNECTION SECTION
1034
DEVICE DATABASE
1031
COMMUNICATION SECTION
1063
1061
1004
1062
1050
CONTROL SIGNAL RECEPTION SECTION
1053
PPP CONNECTION SECTION
1054
INSPECTION RESULT FILE PREPARATION SECTION
1051
COMMUNICATION SECTION
1052

FIG. 9

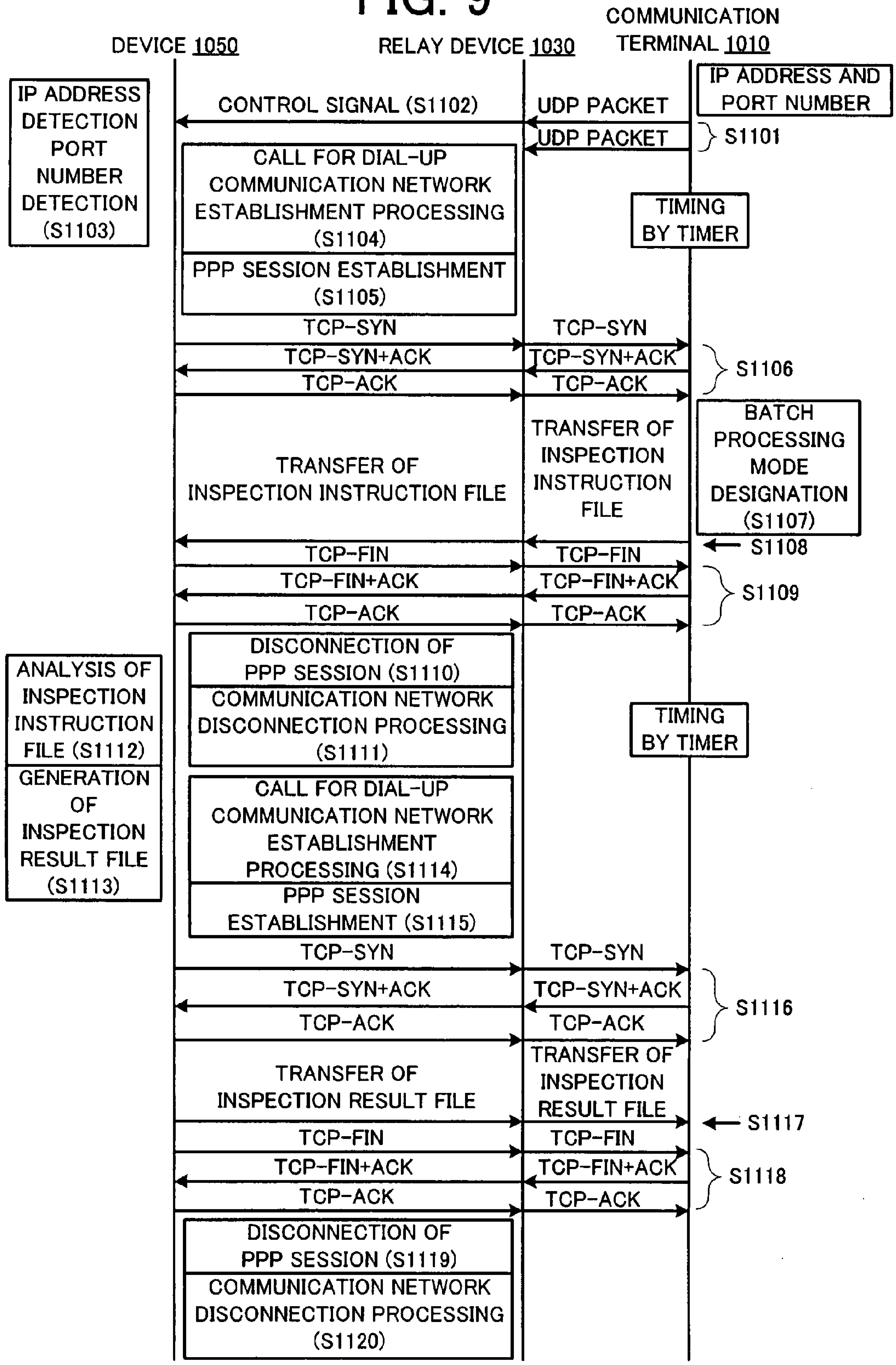

COMMUNICATION TERMINAL 1010
DEVICE 1050
RELAY DEVICE 1030
IP ADDRESS AND PORT NUMBER
IP ADDRESS DETECTION PORT NUMBER DETECTION (S1103)
CONTROL SIGNAL (S1102)
UDP PACKET
UDP PACKET
S1101
CALL FOR DIAL-UP COMMUNICATION NETWORK ESTABLISHMENT PROCESSING (S1104)
TIMING BY TIMER
PPP SESSION ESTABLISHMENT (S1105)
TCP-SYN
TCP-SYN
TCP-SYN+ACK
TCP-SYN+ACK
S1106
TCP-ACK
TCP-ACK
TRANSFER OF INSPECTION INSTRUCTION FILE
TRANSFER OF INSPECTION INSTRUCTION FILE
BATCH PROCESSING MODE DESIGNATION (S1107)
S1108
TCP-FIN
TCP-FIN
TCP-FIN+ACK
TCP-FIN+ACK
S1109
TCP-ACK
TCP-ACK
DISCONNECTION OF PPP SESSION (S1110)
ANALYSIS OF INSPECTION INSTRUCTION FILE (S1112)
COMMUNICATION NETWORK DISCONNECTION PROCESSING (S1111)
TIMING BY TIMER
GENERATION OF INSPECTION RESULT FILE (S1113)
CALL FOR DIAL-UP COMMUNICATION NETWORK ESTABLISHMENT PROCESSING (S1114)
PPP SESSION ESTABLISHMENT (S1115)
TCP-SYN
TCP-SYN
TCP-SYN+ACK
TCP-SYN+ACK
S1116
TCP-ACK
TCP-ACK
TRANSFER OF INSPECTION RESULT FILE
TRANSFER OF INSPECTION RESULT FILE
S1117
TCP-FIN
TCP-FIN
TCP-FIN+ACK
TCP-FIN+ACK
S1118
TCP-ACK
TCP-ACK
DISCONNECTION OF PPP SESSION (S1119)
COMMUNICATION NETWORK DISCONNECTION PROCESSING (S1120)

FIG. 10

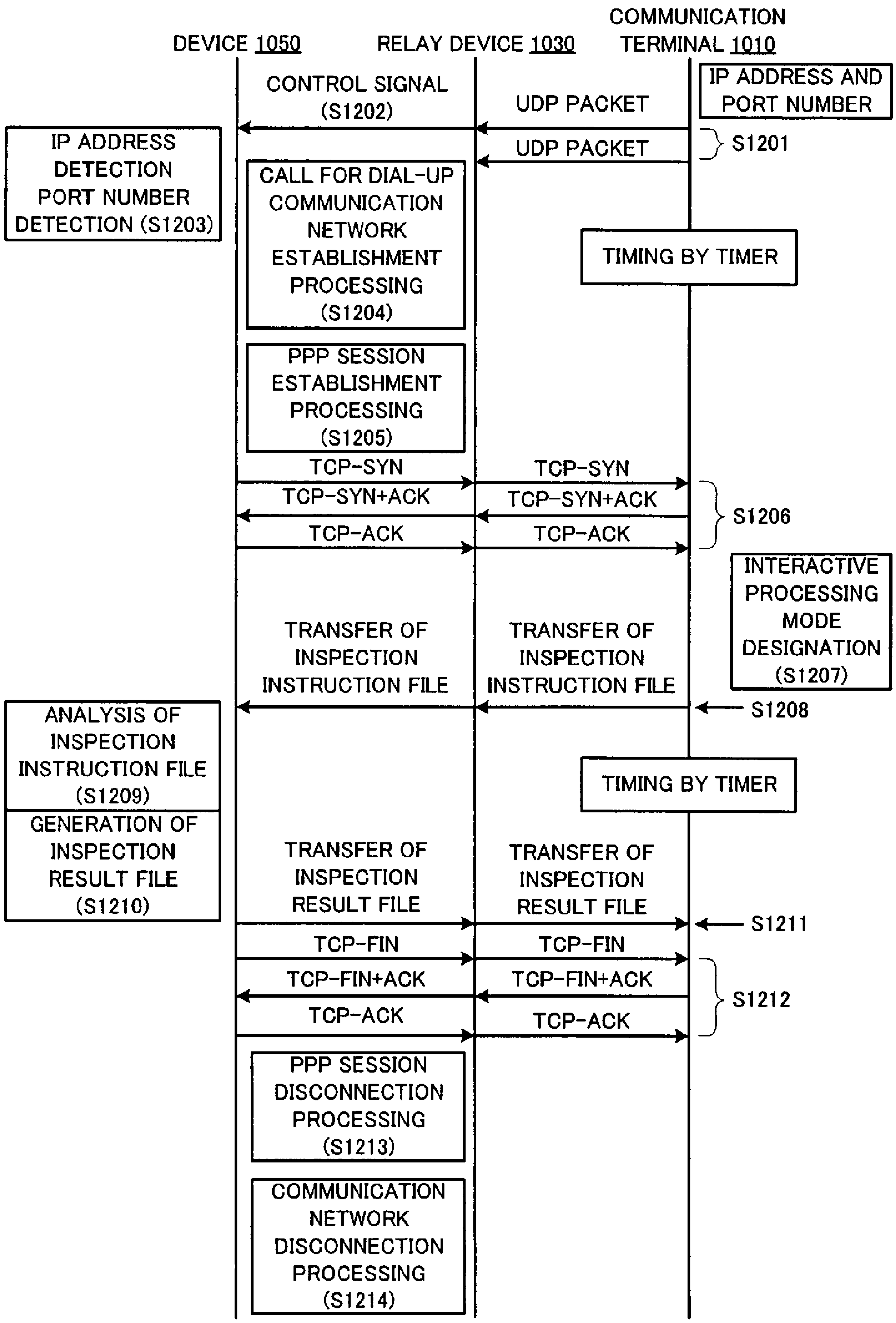

DEVICE 1050
RELAY DEVICE 1030
COMMUNICATION TERMINAL 1010
IP ADDRESS AND PORT NUMBER
CONTROL SIGNAL (S1202)
UDP PACKET
UDP PACKET
S1201
IP ADDRESS DETECTION PORT NUMBER DETECTION (S1203)
CALL FOR DIAL-UP COMMUNICATION NETWORK ESTABLISHMENT PROCESSING (S1204)
TIMING BY TIMER
PPP SESSION ESTABLISHMENT PROCESSING (S1205)
TCP-SYN
TCP-SYN
TCP-SYN+ACK
TCP-SYN+ACK
TCP-ACK
TCP-ACK
S1206
INTERACTIVE PROCESSING MODE DESIGNATION (S1207)
TRANSFER OF INSPECTION INSTRUCTION FILE
TRANSFER OF INSPECTION INSTRUCTION FILE
S1208
ANALYSIS OF INSPECTION INSTRUCTION FILE (S1209)
TIMING BY TIMER
GENERATION OF INSPECTION RESULT FILE (S1210)
TRANSFER OF INSPECTION RESULT FILE
TRANSFER OF INSPECTION RESULT FILE
S1211
TCP-FIN
TCP-FIN
TCP-FIN+ACK
TCP-FIN+ACK
TCP-ACK
TCP-ACK
S1212
PPP SESSION DISCONNECTION PROCESSING (S1213)
COMMUNICATION NETWORK DISCONNECTION PROCESSING (S1214)

FIG. 11

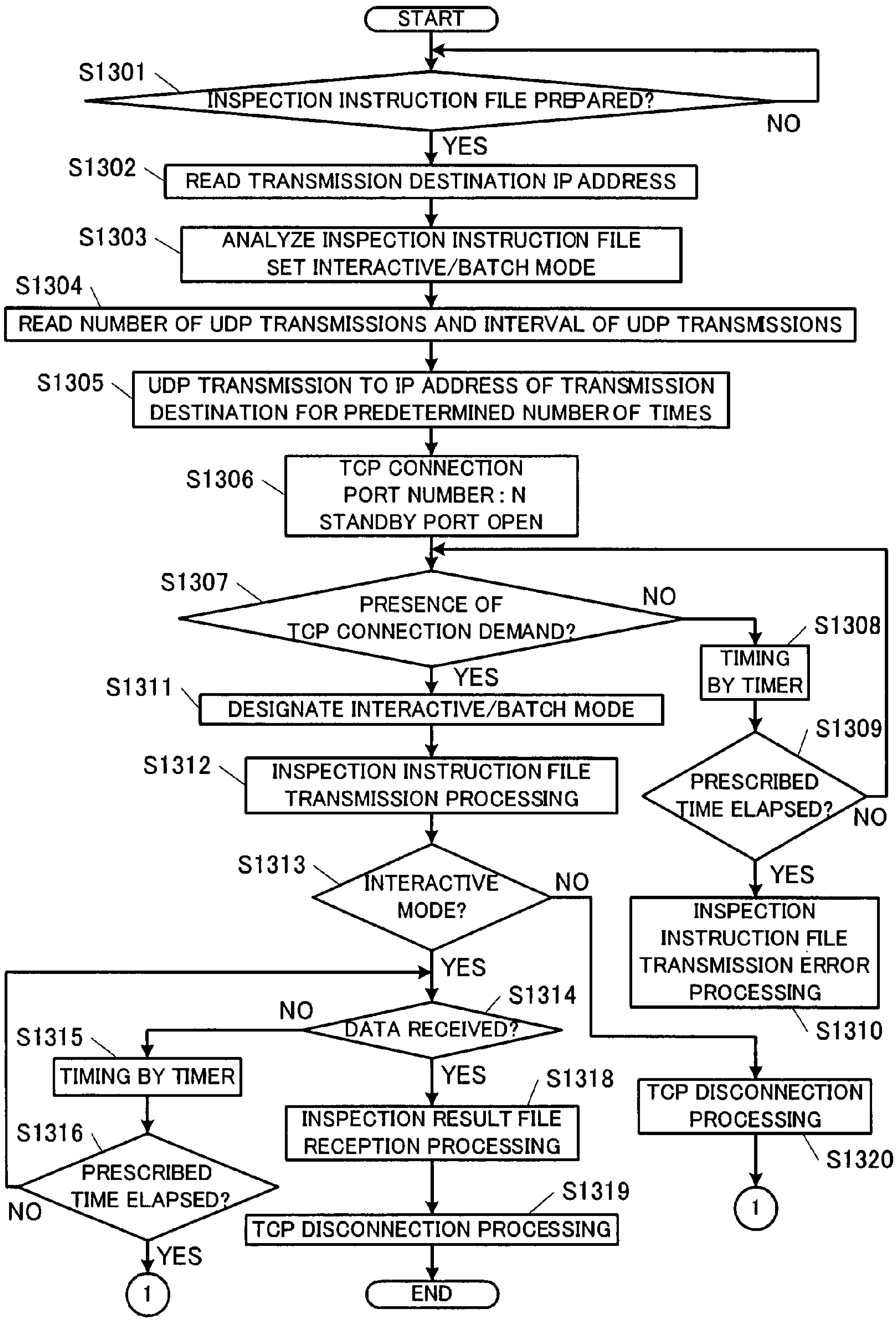

START
S1301
INSPECTION INSTRUCTION FILE PREPARED?
NO
YES
S1302
READ TRANSMISSION DESTINATION IP ADDRESS
S1303
ANALYZE INSPECTION INSTRUCTION FILE
SET INTERACTIVE/BATCH MODE
S1304
READ NUMBER OF UDP TRANSMISSIONS AND INTERVAL OF UDP TRANSMISSIONS
S1305
UDP TRANSMISSION TO IP ADDRESS OF TRANSMISSION DESTINATION FOR PREDETERMINED NUMBER OF TIMES
S1306
TCP CONNECTION
PORT NUMBER : N
STANDBY PORT OPEN
S1307
PRESENCE OF TCP CONNECTION DEMAND?
NO
S1308
TIMING BY TIMER
S1309
PRESCRIBED TIME ELAPSED?
NO
YES
INSPECTION INSTRUCTION FILE TRANSMISSION ERROR PROCESSING
S1310
YES
S1311
DESIGNATE INTERACTIVE/BATCH MODE
S1312
INSPECTION INSTRUCTION FILE TRANSMISSION PROCESSING
S1313
INTERACTIVE MODE?
NO
YES
S1314
DATA RECEIVED?
NO
S1315
TIMING BY TIMER
S1316
PRESCRIBED TIME ELAPSED?
NO
YES
1
YES
S1318
INSPECTION RESULT FILE RECEPTION PROCESSING
S1319
TCP DISCONNECTION PROCESSING
END
TCP DISCONNECTION PROCESSING
S1320
1

FIG. 12

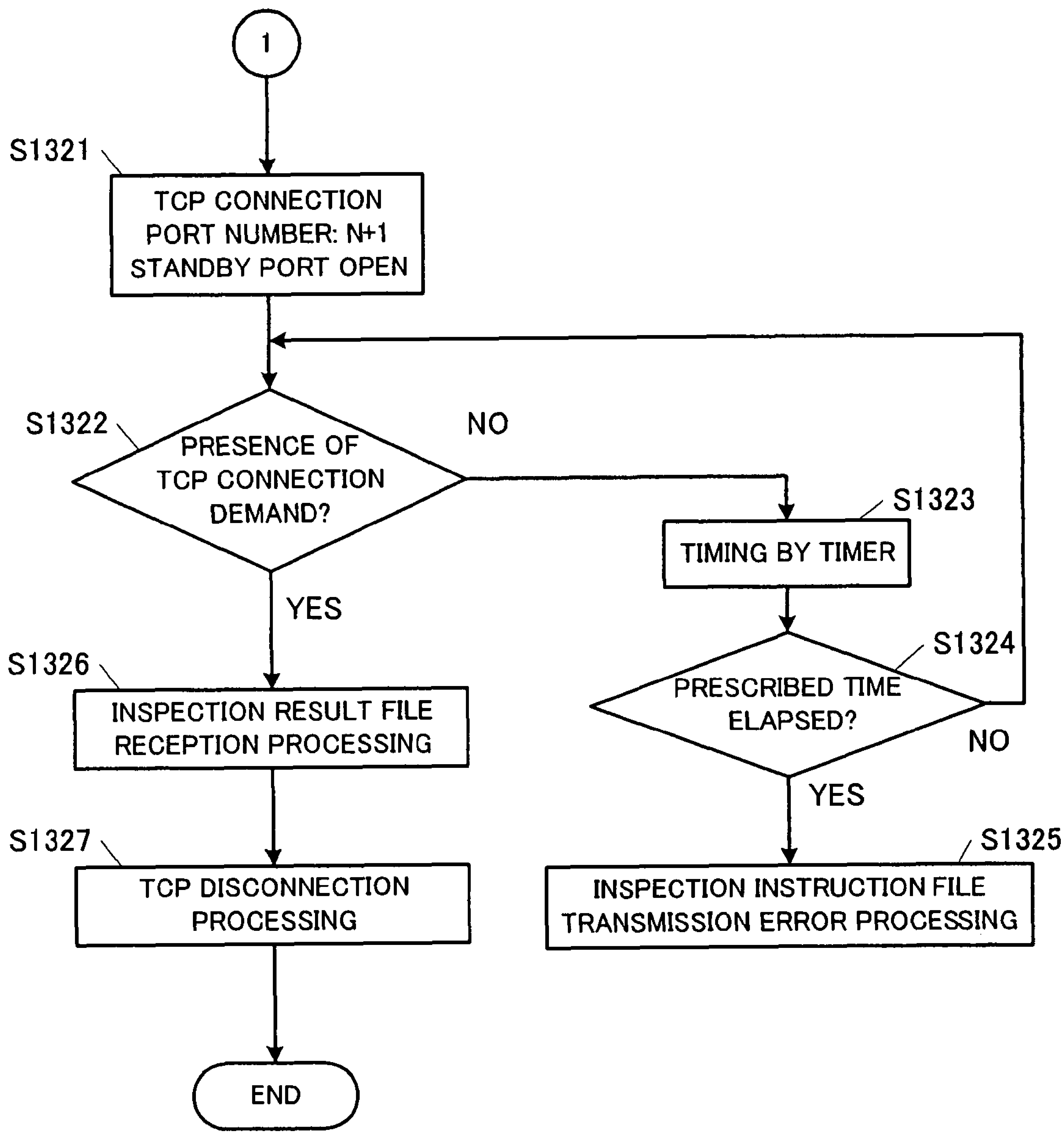

1
S1321
TCP CONNECTION PORT NUMBER: N+1 STANDBY PORT OPEN
S1322
PRESENCE OF TCP CONNECTION DEMAND?
NO
S1323
TIMING BY TIMER
S1324
PRESCRIBED TIME ELAPSED?
NO
YES
S1325
INSPECTION INSTRUCTION FILE TRANSMISSION ERROR PROCESSING
YES
S1326
INSPECTION RESULT FILE RECEPTION PROCESSING
S1327
TCP DISCONNECTION PROCESSING
END

FIG. 13

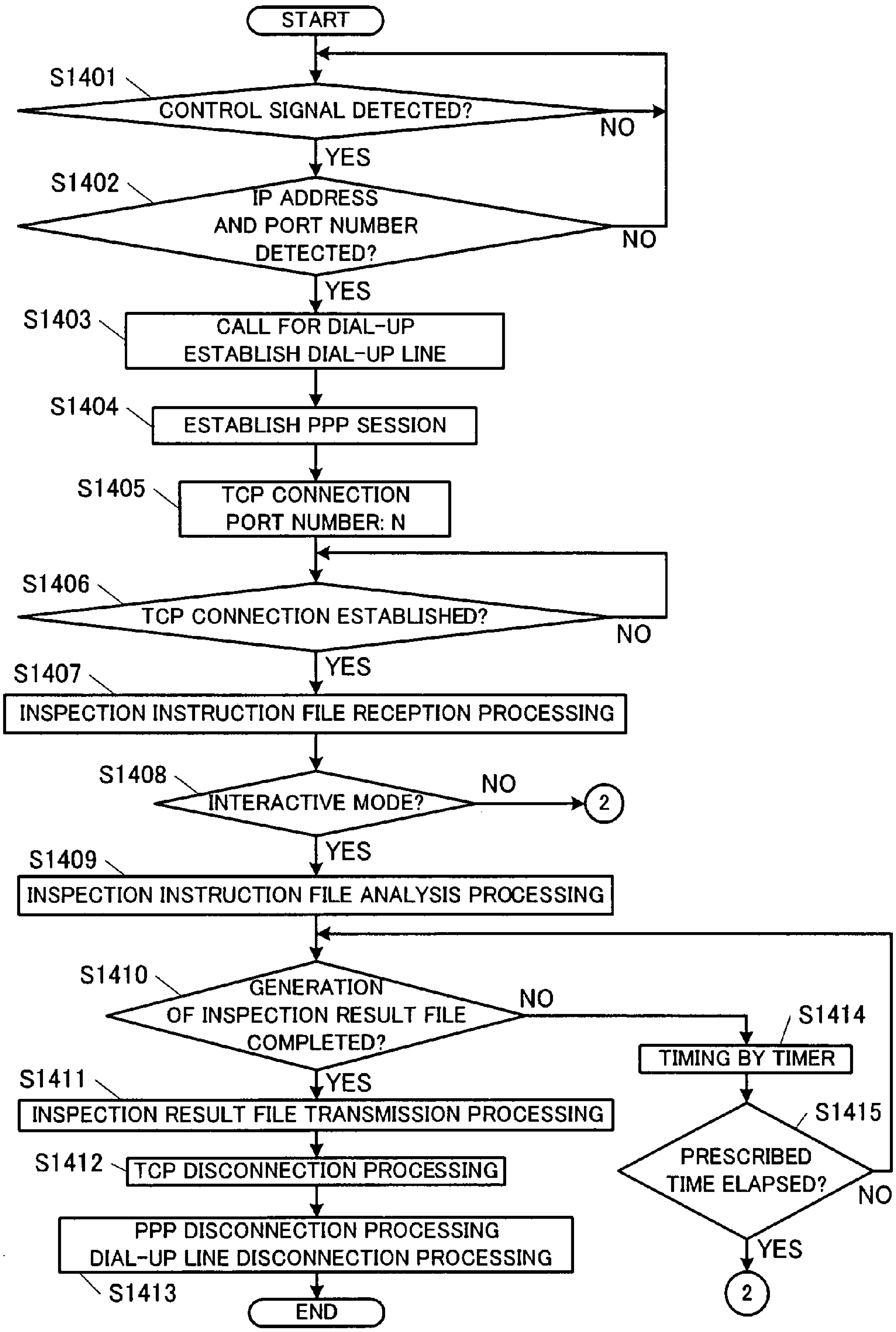
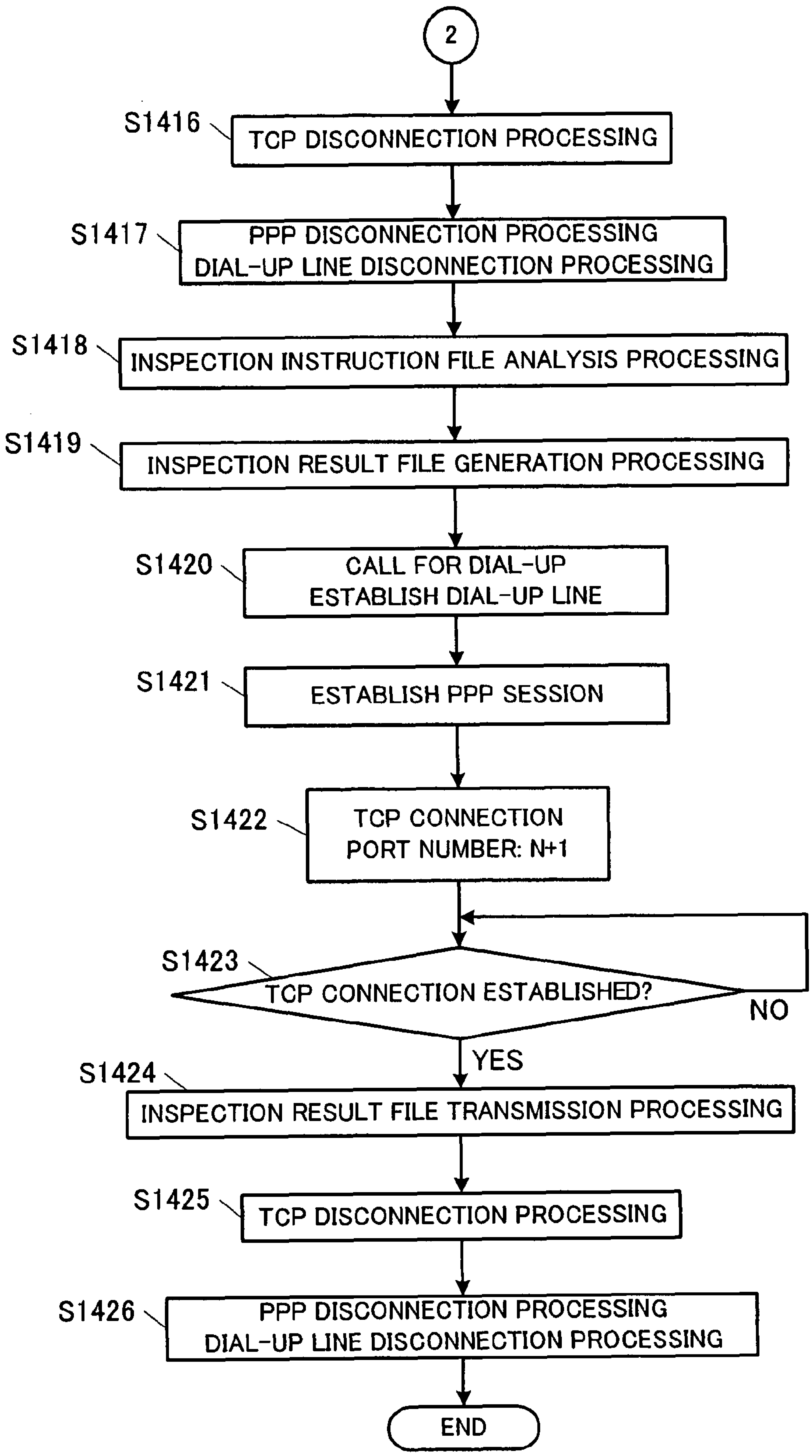

START
S1401
CONTROL SIGNAL DETECTED?
NO
YES
S1402
IP ADDRESS AND PORT NUMBER DETECTED?
NO
YES
S1403
CALL FOR DIAL-UP
ESTABLISH DIAL-UP LINE
S1404
ESTABLISH PPP SESSION
S1405
TCP CONNECTION
PORT NUMBER: N
S1406
TCP CONNECTION ESTABLISHED?
NO
YES
S1407
INSPECTION INSTRUCTION FILE RECEPTION PROCESSING
S1408
INTERACTIVE MODE?
NO
2
YES
S1409
INSPECTION INSTRUCTION FILE ANALYSIS PROCESSING
S1410
GENERATION OF INSPECTION RESULT FILE COMPLETED?
NO
S1414
TIMING BY TIMER
S1415
PRESCRIBED TIME ELAPSED?
NO
YES
2
YES
S1411
INSPECTION RESULT FILE TRANSMISSION PROCESSING
S1412
TCP DISCONNECTION PROCESSING
PPP DISCONNECTION PROCESSING
DIAL-UP LINE DISCONNECTION PROCESSING
S1413
END

FIG. 14


2
S1416
TCP DISCONNECTION PROCESSING
S1417
PPP DISCONNECTION PROCESSING
DIAL-UP LINE DISCONNECTION PROCESSING
S1418
INSPECTION INSTRUCTION FILE ANALYSIS PROCESSING
S1419
INSPECTION RESULT FILE GENERATION PROCESSING
S1420
CALL FOR DIAL-UP
ESTABLISH DIAL-UP LINE
S1421
ESTABLISH PPP SESSION
S1422
TCP CONNECTION
PORT NUMBER: N+1
S1423
TCP CONNECTION ESTABLISHED?
NO
YES
S1424
INSPECTION RESULT FILE TRANSMISSION PROCESSING
S1425
TCP DISCONNECTION PROCESSING
S1426
PPP DISCONNECTION PROCESSING
DIAL-UP LINE DISCONNECTION PROCESSING
END

COMMUNICATION SYSTEM AND REMOTE DIAGNOSIS SYSTEM

This application claims priority under 35 U.S.C. 119 to Japanese Patent Application No. 2006-157331, filed on Jun. 6, 2006 and No. 2006-157332, filed on Jun. 6, 2006, which applications are hereby incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a communication processing technique in a communication system including a terminal of a non-continuous connection.

2. Description of Related Art

As a connection mode of a terminal to a network, a continuous connection and a non-continuous connection are given as examples. When a terminal is continuously connected to a network, a fixed IP address can be assigned to the terminal. Accordingly, in a communication system including a continuously connected terminal, communication can be performed by establishing a TCP connection to this terminal at an arbitrary time. Meanwhile, when the terminal is non-continuously connected to the network, the IP address of the terminal is not fixed, and therefore skill is required for making communication to this terminal. For example, when the terminal is connected to the network through a dial-up, the IP address is assigned to this terminal from a dial-up server every time the dial-up connection is made. Accordingly, the TCP connection cannot be established to this terminal at an arbitrary time.

Japanese Patent Laid-Open Publication No. 2005-210575 proposes a technique for promptly making data communication even when a terminal without a fixed IP address is included in an information system. Specifically, in Japanese Patent Laid-Open Publication No. 2005-210575, a continuously fixed IP address is not assigned to an IP adapter **40**. This IP adapter **40** periodically transmits a UDP packet to a server **42**, and periodically reports the IP address of its own device. Then, when a control request signal is generated to the server **42** from a cellular phone **44**, the server **42** can instantly connect with the IP adapter **40**, because the IP address of the IP adapter **40** is known. Thus, when a trigger of processing is generated from the cellular phone **44**, it is possible to perform data communication promptly through the server **42** and the IP adapter **40**.

As described above, when the terminal making a non-continuous connection is included in the communication system, skill is required for making connection to this terminal. According to Japanese Patent Laid-Open Publication No. 2005-210575, the UDP packet is periodically transmitted to the server by the terminal (IP adapter **40**) on a receiving side, thereby continuously reporting the IP address of its own device.

However, the terminal on the receiving side must continue to send the UDP packet all the time. Even if a transmission request from a transmitting side is not generated, the UDP packet must be continuously sent to the server, and this is inefficient.

Also, for example, when there are a plurality of terminals non-continuously connected to the communication system, the UDP packet is continuously transmitted to the server from all of these terminals, and this is not only inefficient but also imposes a substantial load on the server.

In addition, when a non-continuous communication line network is used, another problem is involved. In a line network of the non-continuous communication, in some cases, it is difficult for a particular terminal to maintain a communication state. For example, in order to provide a service to many users, the line in which no traffic is generated for a prescribed time is sometimes disconnected. When the transmission of a packet is not performed for a prescribed time, this line may sometimes be disconnected depending on the type of the dial-up router.

In this way, in the communication system including the terminal of the non-continuous connection, first, skill is required for making a communicable state promptly, and further skill is required for maintaining the communication state until transmission and reception of required information is completed. This is because when a communication error, etc. occurs in the middle of the transmission and reception of data, a recovery processing is required, thus involving a complicated processing.

Therefore, in view of the above-described problems, an object of the present invention is to provide a technique capable of promptly and efficiently starting communication processing when a demand for communication is generated, in a communication system including the terminal of the non-continuous connection.

In addition, another object of the present invention is to provide a technique for promptly and efficiently starting the communication processing when the demand for communication is generated and for normally completing the communication, in a communication system including the terminal of the non-continuous connection.

SUMMARY OF THE INVENTION

In order to overcome the problems described above, preferred embodiments of the present invention provide a communication system including a first communication device, a relay device which is continuously connected to the first communication device, and a second communication device which is connected to the relay device by a communication network established by a connection demand from the second communication device. The first communication device includes a unit for transmitting to the relay device a UDP packet targeted to the second communication device, the relay device includes a unit for transmitting a control signal to the second communication device by using prescribed means, when the UDP packet transmitted from the first communication device is received, and the second communication device includes a unit for establishing the communication network by making the connection demand to the relay device and transmitting a TCP connection demand to the first communication device, when the control signal is received.

In addition, the first communication device repeatedly transmits the UDP packet to the second communication device a prescribed number of times.

In addition, the first communication device transmits to a standby status for the TCP connection from the second communication device, after the UDP packet is transmitted a prescribed number of times.

Another preferred embodiment of the present invention provides a remote diagnosis system including a control device, a relay device which is continuously connected to the control device, and an inspection target device which is connected to the relay device by a communication network established by a connection demand from the inspection target device. The control device includes a unit for transmitting a UDP packet to the inspection target device, the relay device includes a unit for transmitting a control signal to the inspection target device by using prescribed means when the UDP packet transmitted from the control device is received, the inspection target device includes a unit for establishing the communication network by making the connection demand to the relay device and transmitting a TCP connection demand to the control device, when the control signal is received, and by the TCP connection demand from the inspection target device, a TCP connection is established between the control device and the inspection target device, and thereafter the control device transmits an inspection instruction file to the inspection target device by using this TCP connection.

In addition, the inspection device that receives the inspection instruction file conducts an inspection according to the inspection instruction file, and thereafter transmits an inspection result file to the control device by using the TCP connection used when the inspection instruction file is transmitted.

In addition, the control device repeatedly transmits the UDP packet to the inspection target device a prescribed number of times.

In addition, the control device transmits to a standby status for the TCP connection from the inspection target device, after the UDP packet is transmitted a prescribed number of times.

Further, another embodiment of the present invention provides a communication system including a first communication device, a relay device which is continuously connected to the first communication device, and a second communication device which is connected to the relay device by a communication network established by a connection demand from the second communication device. The second communication device includes a unit for establishing the communication network by making the connection demand to the relay device and transmitting a TCP connection demand to the first communication device, the first communication device includes a unit for establishing a TCP connection with the second communication device by the TCP connection demand from the second communication device and transmitting a transmission file to the second communication device by designating a reply mode, and the second communication device transmits a reply file while maintaining the TCP connection used in receiving the transmission file when a first mode is designated as the reply mode, and when a second mode is designated, disconnects the communication network with the relay device, and after a communication network with the relay device is established again, establishes a new TCP connection and transmits the reply file.

In addition, the second communication device establishes the communication network again after the communication network with the relay device is disconnected and when the transmission of the reply file is prepared.

In addition, even when the first mode is designated as the reply mode, the second communication device disconnects the communication network with the relay device when it determines that the time required for reply processing of the reply file corresponds to a prescribed condition, and after establishing the communication network with the relay device again, establishes a new TCP connection and transmits the reply file.

According to the communication system of the present invention, when the relay device receives the UDP packet from the first communication device, the control signal is transmitted to the second communication device, and after the second communication device establishes the communication network by making the connection demand to the relay device, the TCP connection demand is transmitted to the first connection device. Accordingly, when the communication network is established between the second communication device and the relay device, the TCP connection can be established with the first communication device at an early timing. Namely, when the communication demand is generated to the second communication device from the first communication device, the communication processing can be started at an early timing.

Then, when the transmission request is generated, the UDP packet is transmitted from the first communication device on the side of generating the transmission request, and therefore an efficient system configuration is possible without transmitting a number of UDP packets even when there is no need for communication.

In addition, the first communication device repeatedly transmits the UDP packet to the second communication device a prescribed number of times. Unlike the TCP packet, in a case of the UDP packet, re-transmission processing is not performed, and therefore the connection demand can surely be sent to the second communication device without complicating a control.

After the UDP packet is transmitted a prescribed number of times, the first communication device transmits to the standby status for the TCP connection from the second communication device. Since the first communication device of a demand source transmits to the standby status, the TCP connection can be established instantly at the point in time when the TCP connection demand from the second communication is generated.

In addition, the communication system according to the present invention designates whether or not the second communication device transmits the reply file by using the same connection as the TCP connection used when the first communication device transmits the transmission file, or whether or not the reply file is transmitted by using a new TCP connection after the line is disconnected once. Thus, in the second communication terminal, it is possible to prevent such a situation that a time is required for processing the reply file, and the line is disconnected during the reply processing, thus complicating the processing. For example, when it is previously known that a time is required for preparing the reply file, the processing is smoothly performed by setting a mode of disconnecting the line once.

In addition, even when the first communication device designates to return the reply file while maintaining the TCP connection at the time of transmitting the transmission file, the second communication device disconnects the communication network once when the processing of the reply file corresponds to a prescribed condition. Thus, when a time is required for reply processing under an unexpected circumstance, the communication network is re-connected. Therefore, the processing can be completed under a normal condition, without allowing a processing error to be generated.

Other features, elements, processes, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of preferred embodiments of the present invention with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram illustrating a system configuration of a remote diagnosis system according to a first embodiment;

FIG. **2** is a block diagram of each device constituting the remote diagnosis system according to the first embodiment;

FIG. **3** is a view illustrating an entire processing sequence of the remote diagnosis system according to the first embodiment;

FIG. **4** is a processing flowchart of a communication terminal according to the first embodiment;

FIG. **5** is a processing flowchart of a device in a factory according to the first embodiment;

FIG. **6** is a view illustrating a processing sequence according to the first embodiment where a TCP packet is used;

FIG. **7** is a block diagram illustrating a system configuration of a remote diagnosis system according to a second embodiment;

FIG. **8** is a block diagram of each device constituting the remote diagnosis system according to the second embodiment;

FIG. **9** is a view illustrating an entire processing sequence in batch mode of the remote diagnosis system according to the second embodiment;

FIG. **10** is a view illustrating an entire processing sequence in interactive mode of the remote diagnosis system according to the second embodiment;

FIG. **11** is a processing flowchart of the communication terminal according to the second embodiment;

FIG. **12** is a processing flowchart of the communication terminal according to the second embodiment;

FIG. **13** is a processing flowchart of the device in a factory according to the second embodiment; and

FIG. **14** is a processing flowchart of the device in the factory according to the second embodiment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

(First embodiment) Preferred embodiments of the present invention will be described below with reference to the drawings. FIG. **1** is a block diagram illustrating a system configuration of a remote diagnosis system according to the present embodiment. This remote diagnosis system includes a communication terminal **10** installed in a center **1**; a relay device **30**; and devices **50** installed in a factory **5**. The communication terminal **10** and the relay device **30** are connected through the Internet **2**. In addition, the relay device **30** and each device **50** are connected through a public telephone line network **4**.

This remote diagnosis system is a system for remotely conducting a diagnosis on the device **50** in the factory **5** from a center **1** at a distant place. Specifically, this is a system in which an inspection instruction file **61** is transmitted to the device **50** through a network from the communication terminal **10** at the center **1**, and an result of the inspection executed in the device **50** is returned to the communication terminal **10** from the device **50** through the network, as an inspection result file **62**. Thus, it is possible to give a diagnosis on a condition of the device **50** in the factory **5**, in the center **1** that exists at a distant place.

Here, the communication terminal **10** and the relay device **30** are continuously connected to the Internet **2**. Namely, fixed IP addresses are assigned to the communication terminal **10** and the relay device **30**. Accordingly, the communication terminal **10** and the relay device **30** can establish the TCP connection by issuing a TCP connection demand from either of the terminals (devices), when the communication needs to be performed.

Meanwhile, the relay device **30** and each device **50** are connected through a public telephone line network **4** physically. However, by making a dial-up connection to the relay device **30** from the device **50**, a communicable condition can be achieved for the first time. Contrarily, the dial-up connection cannot be made from the relay device **30** to the device **50**. Namely, in order to perform communication between the relay device **30** and the device **50**, the dial-up connection needs to be made from the device **50**.

FIG. **2** is a functional block diagram of the communication terminal **10**, the relay device **30**, and the device **50**. The communication terminal **10** includes an inspection instruction file preparation section **11**, a communication section **12**, an operation section **13**, a monitor **14**, a device database **15**, and an inspection start request section **16**.

The inspection instruction file preparation section **11** is a processing section for preparing an inspection instruction file **61** in which an inspection item and an inspection instruction command to the device **50** are written. An operator of the communication terminal **10** operates the operation section **13** and gives an instruction to the inspection instruction file preparation section **11**, and prepares the inspection instruction file **61**. The operator prepares the inspection instruction file **61** while confirming an inspection content displayed on a monitor **14**.

The communication section **12** is the processing section for performing transmission/reception of data with another computer by using a protocol such as TCP/IP. The communication section **12** performs transmission/reception of data with the relay device **30** through the Internet **2**. Alternately, when the device **50** is connected through a dial-up, the communication section **12** performs transmission/reception of data with the device **50** through the public telephone line network **4**.

The device database **15** is a database regarding the devices **50** installed in the factory **5**. Specifically, a device name and the IP address are associated with each other and managed therein. A number of devices **50** are installed in the factory **5**. The device name and the IP address regarding all of the devices **50** are associated with each other and managed in the device database **15**.

The inspection start request section **16** is the processing section for sending the UDP packet to a device **50** being an inspection target, when the inspection of the device **50** is started. As described above, the operator gives an instruction to the inspection instruction file preparation section **11** and prepares the inspection instruction file **61**. However, at this time, the operator performs an operation for selecting the device **50** as the inspection target. When this selecting operation is performed, the inspection instruction file preparation section **11** refers to the device database **15**, and acquires the IP address of the selected device **50**. Then, the inspection instruction file preparation section **11** writes the device name and the IP address of the device **50**, or a diagnosis target, in the inspection instruction file **61**. Accordingly, by referring to the inspection instruction file **61**, the inspection start request section **16** can know the IP address of the device **50**, or the diagnosis target, and sends the UDP packet destined for this IP address.

The relay device **30** includes a communication section **31**, a control signal transmission section **32**, a PPP connection section **33**, and a device database **34**. The communication section **31** is the processing section for performing transmission/reception of data with another computer by using a protocol such as TCP/IP. The communication section **31** performs transmission/reception of data with the communication terminal **10** through the Internet **2**. In addition, when the device **50** is connected through a dial-up, the transmission section **31** performs transmission/reception of data with the device **50** through the public telephone line network **4**.

The control signal transmission section **32** is the processing section for transmitting a control signal **63** to the device **50**. In this embodiment, the control signal transmission section **32** transmits the control signal **63** to the device **50**, by using the public telephone line network **4** and by using a particular frequency band which does not interfere with the data communication. In addition, for example, the control signal **63** may be transmitted through wireless transmission. Alternately, another line other than a telephone line may be used.

Specifically, the control signal **63** transmitted by the control signal transmission section **32** is a connection start demand signal to the device **50**. Namely, it is a signal demanding the device **50** which is not connected through a dial-up to make the dial-up connection via the public telephone line network **4**.

The PPP connection section **33** is the processing section for receiving a demand for the dial-up connection and an establishment of a PPP (Point to Point) session from the device **50** and making the dial-up connection and establishing the PPP session.

The device database **34** is a database regarding the device **50** installed in the factory **5**. Specifically, the device database **34** manages the device name of the device **50**, identification information of the device **50** (namely, device identification information designated to be a transmission destination of the control signal **63**), and the IP address such that they are corresponded to one another. A number of devices **50** are installed in the factory **5**. The device name, the device identification information, and the IP address regarding all of the devices **50** are managed in the device database **34** such that they are corresponded to one another.

The device identification information is the information for specifying the transmission destination to which the control signal transmission section **32** transmits the control signal **63**. The information unique to each device **50** is assigned as the device identification information so as to uniquely specify each device **50**. A number of devices **50** are installed in the factory **5**. Accordingly, the relay device **30** needs to specify the device **50**, or the inspection target, and to transmit the control signal **63**. Therefore, this device identification information is used. Specifically, the device identification information is embedded in the control signal **63**. The device **50** receives the control signal **63** when it identifies that the device identification information is of its own device.

The device name and the IP address of the device **50** are also registered in this device database **34**, and this IP address is identical to the IP address registered in the device database **15** of the communication terminal **10**. Namely, the relay device **30** reserves the IP address to be assigned to the device **50** that makes the dial-up connection. Namely, it is previously determined which IP address is assigned to which device **50**. Then, this correspondence information is reflected on the device database **15** of the communication terminal **10**.

The device **50** includes an inspection result file preparation section **51**, a communication section **52**, a control signal reception section **53**, and a PPP connection section **54**. The inspection result file preparation section **51** is the processing section for preparing an inspection result file **62** in which the inspection result is described after the inspection on the device **50** is conducted. Specifically, the inspection on the device **50** is conducted based on an inspection item or an inspection instruction command written in the inspection instruction file **61** received from the communication terminal **10**, and the result thereof is returned to the communication terminal **10** as the inspection result file **62**.

The communication section **52** is the processing section for performing transmission/reception of data with another computer by using a protocol such as TCP/IP. When the device **50** is connected through a dial-up, the communication section **52** performs the transmission/reception of data with the relay device **30** through the public telephone line network **4**.

The control signal reception section **53** receives the control signal **63** transmitted from the control signal transmission section **32**. When the identification information of its own device is identical to the device identification information included in the control signal **63** thus transmitted, the control signal reception section **53** determines that this control signal **63** is a signal for its own device, and performs reception processing of this control signal **63**.

The PPP connection section **54** is the processing section for making a demand for the dial-up connection and an establishment of the PPP session, to the relay device **30**. When the control signal **63** identical to the identification information of its own device is received from the relay device **30**, the device **50** makes a demand for the dial-up connection and the establishment of the PPP session, to the relay device **30**.

A processing sequence of the aforementioned remote diagnosis system will be described. FIG. **3** is a view illustrating the processing sequence among the communication terminal **10**, the relay device **30**, and the device **50**.

First, the operator operates the communication terminal **10** and gives an instruction to start the inspection. Specifically, the operator operates the operation section **13** and performs an operation for designating the device **50**, or the inspection target, and an operation for designating the inspection item. In response to this operation, the inspection instruction file preparation section **11** prepares the inspection instruction file **61**. Further, the inspection start request section **16** transmits the UDP packet to the designated device **50** (step S**101**).

As described above, the inspection start request section **16** can acquire the IP address of the device **50**, or the transmission destination, by referring to the inspection instruction file **61**, and thus the UDP packet is sent to this IP address. In addition, the inspection start request section **16** designates a port number of a standby TCP port in the UDP packet. A previously defined number may be used as the port number of the standby TCP port.

The inspection start request section **16** sends the UDP packet a plurality of times at a prescribed interval such as one second. When the UDP packet is sent a plurality of times by the inspection start request section **16**, the communication terminal **10** starts timing by a timer and transmits to a standby status for the TCP connection.

Next, the UDP packet sent from the communication terminal **10** is intermediately received by the relay device **30**. Then, the relay device **30** transmits the control signal **63** to the device **50** corresponding to the IP address of the transmission destination of the UDP packet (step S**102**). The relay device **30** acquires the IP address of the transmission destination from the UDP packet, and specifies the device **50** to which this IP address is assigned, by referring to the device database **34**. In addition, the device identification information of the device **50** can be obtained by referring to the device database **34**. Therefore, the relay device **30** transmits the control signal **63** in which the device identification information is designated to each device **50** by using a particular frequency band. Here, the relay device **30** includes in the control signal **63** the information on the IP address and the port number of the communication terminal **10** from which the transmission is performed.

Next, the device **50** having the device identification number identical to the designated device identification number receives the control signal **63**. Then, this device **50** acquires the IP address and the port number of the communication terminal **10**, or the transmission source, from the received control signal **63** (step S**103**).

Next, the PPP connection section **54** calls for a dial-up and performs the establishment processing of the dial-up line network. The PPP connection section **33** of the relay device **30** responds to this call, and the dial-up line network is established (step S**104**). Further, when the PPP connection section **54** makes a demand for the establishment of the PPP session, the PPP session is established between the device **50** and the relay device **30** (step S**105**).

When the PPP session is established, subsequently, the communication section **52** of the device **50** makes a TCP connection demand to the communication section **12** of the communication terminal **10**. Since the IP address and the port number of the communication terminal **10** are acquired in step S**103**, the communication section **52** makes the TCP connection demand targeting the IP address and the port number. Then, a three-way handshake is performed (step S**106**), and the TCP connection is established between the device **50** and the communication terminal **10**.

In this way, the remote diagnosis system according to this embodiment establishes the PPP session from the device **50** that receives the connection demand by the UDP packet, and subsequently the same device **50** establishes the TCP connection. Therefore, at the point in time when the PPP session is established, the TCP connection can be established instantly.

When the TCP connection is established between the device **50** and the communication terminal **10**, the inspection instruction file preparation section **11** transmits the inspection instruction file **61** to the device **50**. The inspection instruction file **61** is transmitted to the device **50** through the relay device **30** (step S**107**).

When the inspection instruction file **61** is received, the device **50** analyzes the content of this file (step S**108**). Namely, the content of the inspection item or the inspection instruction is analyzed. Then, the inspection is executed in accordance with the inspection item or the inspection instruction command written in the inspection instruction file **61**. For example, the number of rotations of the motor in the device **50**, a device temperature of the device **50**, and a remaining memory capacity of the device **50**, etc. are measured. Then, the device **50** prepares the inspection result file **62** in which the result of the conducted inspection is recorded (step S**109**).

When the inspection result file **62** is prepared, the device **50** transmits the inspection result file **62** to the communication terminal **10** (step S**110**). At this time, the inspection result file **62** is transmitted using the TCP connection established in step S**106**. Namely, the transmission result file **62** is returned using the same connection as the TCP connection through which the transmission instruction file **61** is transmitted. When the inspection result file **62** is received, the inspection result is displayed on a monitor **14** in the communication terminal **10**.

After transmitting the inspection result file **62**, the device **50** makes a TCP disconnection demand to the communication terminal **10**. Then, the three-way handshake is performed and the TCP connection is disconnected (step S**111**).

When the TCP connection between the device **50** and the communication terminal **10** is disconnected, the PPP connection section **54** performs the disconnection processing of the PPP session with the PPP connection section **33** (step S**112**), and performs the disconnection processing of the dial-up line network (step S**113**). In this way, after the inspection result file **62** is transmitted, the TCP connection is disconnected, and then the dial-up connection is disconnected.

Hitherto, the entire processing sequence of the remote diagnosis system including the communication terminal **10**, the relay device **30**, and the device **50** has been described. Next, the communication terminal **10** is focused on, and a flow of the remote diagnosis processing for the device **50** will be described. FIG. **4** is a flowchart of the remote diagnosis processing in the communication terminal **10**.

In the previous stage, the inspection instruction file **61** is prepared by the operation of the operator. The inspection instruction file preparation section **11** refers to the device database **15**, acquires the IP address of the device **50**, or the diagnosis target designated by the operator, and writes this IP address in the inspection instruction file **61**.

In this state, first, the inspection start request section **16** checks whether or not the inspection instruction file **61** is prepared (step S**201**), and when it is prepared, reads the IP address of the transmission destination, or the diagnosis target, from the inspection instruction file **61** (step S**202**). Then, the inspection start request section **16** acquires the information of the number of UDP transmissions and an interval of UDP transmissions, from a UDP transmission definition file stored in a storage section not shown (step S**203**), and in accordance with this information, transmits the UDP packet targeting the IP address acquired in step S**202** (step S**204**). For example, the UDP packet is transmitted five times at an interval of one second, for example.

When the UDP packet is transmitted the predetermined number of times, the communication terminal **10** opens the standby port for the TCP connection, and transmits to the standby status for the TCP connection demand (step S**205**). In this manner, it is prepared that the TCP connection be established instantly at the point in time when the TCP connection demand is generated from the device **50**.

Then, when the TCP connection demand is not received (NO in step S**206**), timing by a timer is started (step S**207**), and the TCP connection demand is monitored until a prescribed time elapses (step S**208**). Then, when the TCP connection demand is not received even if the prescribed time elapsed, a transmission error processing of the inspection instruction file **61** is performed (step S**209**). For example, a message reading "transmission of the inspection instruction file is failed" is displayed on the monitor **14**.

When the TCP connection demand is received in step S**206**, the inspection instruction file **61** is transmitted to the device **50** after the TCP connection is established (step S**210**). When the inspection instruction file **61** is transmitted, the communication terminal **10** is set in the standby status as to whether or not data is received (step S**211**), and when the data is not received, timing by a timer is started (step S**212**), and the communication terminal **10** is set in the standby status for data reception until a prescribed time elapses (step S**213**). Then, when the data is not received even if the prescribed time elapsed, a transmission error processing of the inspection instruction file **61** is performed (step S**214**). For example, the message reading "transmission of the inspection instruction file is failed" is displayed on the monitor **14**.

When the data is received in step S**211**, a reception processing of the inspection result file **62** is performed (step S**215**). Namely, the reception processing of the inspection result file **62** returned from the device **50** is performed. Next, the disconnection processing of the TCP connection is performed (step S**216**). The content of the received inspection result recorded in the inspection result file **62** is displayed on the monitor **14**, for example. In this way, the communication terminal **10** can obtain the inspection result.

FIG. **5** is a processing flowchart of a remote diagnosis focusing on the device **50**. The device **50** is set in the standby status for receiving the control signal **63** from the relay device **30** (step S**301**). When the control signal **63** is received, it is checked whether or not the IP address and the port number are included in the control signal **63** (step S**302**). This IP address is the IP address of the communication terminal **10**, or the transmission source of the inspection instruction file **61**, and the port number is the number of the port at which the communication terminal **10** stands by for the TCP connection demand. When the IP address and the port number are not included, the signal is a control signal for another processing. Therefore, the device **50** executes the another processing (not shown), and is set in the standby status for receiving the control signal **63**.

When the IP address and the port number are included in the control signal **63**, the PPP connection section **54** calls for a dial-up to the PPP connection section **33** of the relay device **30**, to establish the dial-up line network (step S**303**). Then, the PPP session is established on the dial-up connection (step S**304**).

Subsequently, the communication section **52** makes the TCP connection demand to the communication terminal **10** by using the IP address and the port number acquired in step S**302** (step S**305**), and is set in a standby status for the establishment of the TCP connection (step S**306**), and when the TCP connection is established, performs the reception processing of the inspection instruction file **61** (step S**307**).

When the inspection instruction file **61** is received, the inspection item or the inspection instruction command written in the inspection instruction file **61** is analyzed (step S**308**), and the inspection is conducted in accordance with this inspection item or the inspection instruction command. After the inspection is conducted, the inspection result file **62** in which the inspection result is written is prepared (step S**309**), and the inspection result file **62** is transmitted to the communication terminal **10** (step S**310**). Namely, the inspection result file **62** is returned using the TCP connection used in transferring the inspection instruction file **61** as it is.

When the transmission of the inspection result file **62** is finished, the disconnection processing of the TCP connection is performed (step S**311**), and the disconnection processing of the PPP session is performed, and finally, the disconnection of the dial-up line network is performed (step S**312**).

In this way, according to the remote diagnosis system of this embodiment, when the inspection is started, the UDP packet is sent from the communication terminal **10** on the side of transmitting the inspection instruction file **61**. Then, the communication terminal **10** that transmits the UDP packet is set in the standby status for the TCP connection. Then, the demands for the connection of the dial-up line and for the TCP connection are made from the device **50** that receives the control signal **63** transmitted based on the UDP packet. Accordingly, at the point in time when the device **50** establishes the line network through the dial-up connection, the TCP connection can be established instantly.

For example, as shown in FIG. **6**, it is possible to consider another method in which the communication terminal **10** transmits not the UDP packet but a TCP-SYN packet. Namely, the UDP packet in this embodiment is replaced with the TCP-SYN packet. Specifically, when the TCP-SYN packet from the communication terminal **10** is received, the relay device **30** transmits the control signal **63** to the device **50**. Then, the device **50** that has received the control signal **63** makes the dial-up connection with the relay device **30**. When the device **50** is connected through the dial-up and the PPP session is established, the device **50** responds to the TCP connection demand sent from the communication terminal **10** and establishes the TCP connection at that point in time.

However, in this case, the communication terminal **10** re-transmits the TCP-SYN packet until an ACK packet for the TCP connection is received. According to a specification of the TCP, the waiting time for the reception of an acknowledgment response is exponentially increased, for example, by two times, and then four times, in a re-transmission processing of the TCP. Accordingly, the communication terminal **10** is controlled as follows. When there is no response to the first TCP-SYN packet (TCP-SYN(**0**) in the figure), the second TCP-SYN packet (TCP-SYN(**1**)) is re-transmitted after waiting for three seconds, for example. When there is no response, the TCP-SYN(**2**) packet is re-transmitted after waiting for six seconds. Next, the TCP-SYN(**3**) is re-transmitted after waiting for twelve seconds.

Accordingly, the TCP connection is not established until a re-transmission timing of the TCP-SYN packet arrives, even after the device **50** is connected through the dial-up and the PPP session is established. For example, as shown in FIG. **6**, it is assumed that the control signal **63** is actually transmitted to the device **50** by the first TCP-SYN(**0**). Then, it is assumed that, just after the third TCP-SYN(**2**) is transmitted, the establishment of the PPP session is completed. In this case also, the three-way handshake is finally performed after the fourth TCP-SYN(**3**) is transmitted after twelve seconds, and the TCP connection is established. Therefore, the establishment of the TCP connection is delayed.

Meanwhile, according to the remote diagnosis system of this embodiment, upon the arrival of the UDP packet at the relay device **30**, the control signal **63** is transmitted to the device **50**, and the dial-up connection, the establishment of the PPP session, and the establishment of the TCP connection are sequentially performed from the device **50**, thus making it possible to establish the TCP connection promptly. Namely, at the point in time when the PPP session is established, the processing can be promptly moved to the TCP connection processing. Thus, in the remote diagnosis system according to this embodiment, when the operator gives a start instruction of the inspection, the inspection result can be obtained in quick response.

In addition, as shown in FIG. **6**, when the inspection start request is made by using the TCP packet, there is a problem that the re-transmission of the TCP packet is performed, thus complicating the control. However, in this embodiment, since the UDP packet is used, the re-transmission processing is not performed and the control is not made complicated, thus making it possible to surely send the control signal **63** to the device **50**. Further, since the UDP packet can be transmitted at an arbitrary interval, the control is easily performed.

Hitherto, the first embodiment of the present invention has been described. However, the connection between the relay device **30** and the device **50** is not limited to the telephone line, but may be a wireless network. Namely, the present invention can generally be applied to a network in which the connection between the device **50** and the relay device **30** are non-continuous connection and the line can be established only from the device **50**. In addition, the present invention can be applied under a condition that the connection between the communication terminal **10** and the relay device **30** is the continuous connection and an exclusive line can be used in addition to the Internet.

(Second embodiment) A second embodiment of the present invention will be described hereunder with reference to the drawings. FIG. **7** is a block diagram illustrating a system configuration of the remote diagnosis system according to this embodiment. This remote diagnosis system includes a communication terminal **110** installed in a center **1001**; a relay device **1030**; and devices **1050** installed in a factory **1005**. The communication terminal **1010** and the relay device **1030** are connected through the Internet **1002**. In addition, the relay device **1030** and each device **1050** are connected through a public telephone line network **1004**.

This remote diagnosis system is a system for remotely conducting a diagnosis on the device **1050** in the factory **1005** from the center **1001** at a distant place. Specifically, an inspection instruction file **1061** is transmitted to the device **1050** through a network from the communication terminal **1010** at the center **1001**, and a result of the inspection conducted on the device **1050** is returned as an inspection result file **1062** to the communication terminal **1010** from the device **1050** through the network. Thus, a diagnosis on the condition of the device **1050** in the factory **1005** can be made in the center **1001** at a distant place.

Here, the communication terminal **1010** and the relay device **1030** are continuously connected to the Internet **1002**. Namely, fixed IP addresses are assigned to the communication terminal **1010** and the relay device **1003**. Accordingly, when the necessity for performing communication occurs, the communication terminal **1010** and the relay device **1030** can establish the TCP connection by sending a TCP connection demand from either of the terminals (devices).

Meanwhile, the relay device **1030** and each device **1050** are connected through the public telephone line network **1004** physically. However, by making a dial-up connection to the relay device **1030** from the device **1050**, a communicable condition is achieved for the first time. Conversely, the dial-up connection cannot be made to the device **1050** from the relay device **1030**. Namely, in order to perform the communication between the relay device **1030** and the device **1050**, the dial-up connection needs to be made from the device **1050**.

FIG. **8** is a functional block diagram of the communication terminal **1010**, the relay device **1030**, and the device **1050**. The communication terminal **1010** includes an inspection instruction file preparation section **1011**, a communication section **1012**, an operation section **1013**, a monitor **1014**, a device database **1015**, and an inspection start request section **1016**.

The inspection instruction file preparation section **1011** is the processing section for preparing an inspection instruction file **1061** in which an inspection item and an inspection instruction command to the device **1050** are written. In addition, the inspection instruction file preparation section **1011** performs the processing of setting reply mode information in a header of the inspection instruction file **1061**. The operator of the communication terminal **1010** operates the operation section **1013**, gives an instruction to the inspection instruction file preparation section **1011**, and prepares the inspection instruction file **1061**. The operator prepares the inspection instruction file **1061** while confirming the inspection content displayed on the monitor **1014**.

The reply mode is a mode for returning the inspection result file **1062** to the communication terminal **1010** by the device **1050**. This mode includes an interactive mode and a batch mode. In the interactive mode, the device **1050** transmits the inspection result file **1062**, keeping the TCP connection used for receiving the inspection instruction file **1061** as it is. In the batch mode, the device **1050** disconnects the TCP connection used for receiving the inspection instruction file **1061**, and establishes another TCP connection and transmits the inspection result file **1062**. More specifically, in the batch mode, after receiving the inspection instruction file **1061**, the device **1050** disconnects the dial-up connection once. Then, when the transmission of the inspection result file **1062** is prepared, the device **1050** makes the dial-up connection again, further establishes a new TCP connection, and transmits the inspection result file **1062**.

The communication section **1012** is the processing section for performing transmission/reception of data with another computer by using a protocol such as TCP/IP. The communication section **1012** performs transmission/reception of data with the relay device **1030** through the Internet **1002**. Alternately, when the device **1050** is connected through a dial-up, the communication section **1012** transmits/receives data with the device **1050** through the Internet **1002** and the public telephone line network **1004**.

The device database **1015** is a database regarding the devices **1050** installed in the factory **1005**. Specifically, the database **1015** manages the device name and the IP address of the device **1050** in such a manner that they are corresponded to each other. A number of devices **1050** are installed in the factory **1005**. In the device database **1015**, the device name and the IP address regarding all of the devices **1050** are managed in such a manner that they are corresponded to each other.

The inspection start request section **1016** is the processing section for sending a UDP packet to the device **1050**, or an inspection target, when the inspection on the device **1050** is started. As described above, the operator gives an instruction to the inspection instruction file preparation section **1011** and prepares the inspection instruction file **1061**. At this time, the operator performs the operation for selecting the device **1050**, or the inspection target. When this selection operation is performed, the inspection instruction file preparation section **1011** refers to the device database **1015** and acquires the IP address of the selected device **1050**. Then, the inspection instruction file preparation section **1011** writes the device name and the IP address of the device **1050**, or an diagnosis target, in the inspection instruction file **1061**. Accordingly, the inspection start request section **1016** can know the IP address of the device **1050**, or the diagnosis target, by referring to the inspection instruction file **1061**, and sends the UDP packet destined to this IP address.

The relay device **1030** includes a communication section **1031**, a control signal transmission section **1032**, a PPP connection section **1033**, and a device database **1034**. The communication section **1031** is the processing section for performing transmission/reception of data with another computer, by using a protocol such as TCP/IP. The communication section **1031** transmits/receives data with the communication terminal **1010** through the Internet **1002**. In addition, when the device **1050** is connected through a dial-up, the communication section **1031** performs transmission/reception of data with the device **1050** through the public telephone line network **1004**.

The control signal transmission section **1032** is the processing section for transmitting a control signal **1063** to the device **1050**. In this embodiment, the control signal transmission section **1032** transmits the control signal **1063** to the device **1050** through the public telephone line network **1004**, using a particular frequency band which does not interfere with the data communication. In addition, for example, the control signal **1063** may be transmitted through wireless transmission. Alternately, a line other than the telephone line may be used.

Specifically, the control signal **1063** transmitted by the control signal transmission section **1032** is a connection start request signal to the device **1050**. Namely, this is a signal demanding a dial-up connection to the device **1050** which is not connected through the dial-up via the public telephone line network **1004**.

The PPP connection section **1033** is the processing section for receiving a demand for a dial-up connection and the establishment of a PPP (Point to point) session from the device **1050**, and making the dial-up connection and the establishment of the PPP session.

The device database **1034** is the database regarding the device **1050** installed in the factory **1005**. Specifically, the device database **1034** manages the device name of the device **1050**, the identification information of the device **1050** (namely, the device identification information designated as the transmission destination of the control signal **1063**) and the IP address, in such a manner that they are corresponded to one another. A number of devices **1050** are installed in the factory **1005**. In the device database **1034**, the device name, the device identification information, and the IP address regarding all of the devices **1050** are managed in such a manner that they are corresponded to one another.

The device identification information is the information for specifying the transmission destination to which the control signal transmission section **1032** transmits the control signal **1063**. As the device identification information, unique information is assigned to each device **1050** so as to uniquely specify each device **1050**. A number of devices **1050** are installed in the factory **1005**. Therefore, the relay device **1030** needs to specify the device **1050**, or the inspection target, and transmit the control signal **1063**. Hence, this device identification information is used. Specifically, the device identification information is embedded in the control signal **1063**. The device **1050** that has received the connection demand receives the control signal **1063** when it identifies that the device identification information is of its own device.

The device name and the IP address of the device **1050** are also registered in this device database **1034**, and this IP address is identical to the IP address registered in the device database **1015** of the communication terminal **1010**. Namely, the relay device **1030** reserves the IP address to be assigned to the device **1050** that makes the dial-up connection. Namely, it is previously determined which IP address is assigned to which device **1050**. Then, this correspondence information is reflected on the device database **1015** of the communication terminal **1010**.

The device **1050** includes an inspection result file preparation section **1051**, a communication section **1052**, a control signal reception section **1053**, and a PPP connection section **1054**. The inspection result file preparation section **1051** is the processing section for preparing the inspection result file **1062** in which the inspection result is described, after the inspection is conducted on the device **1050**. Specifically, the inspection on the device **1050** is conducted based on the inspection item or the inspection instruction command written in the inspection instruction file **1061** received from the communication terminal **1010**, and the result thereof is returned to the communication terminal **1010** as the inspection result file **1062**.

The communication section **1052** is the processing section for performing transmission/reception of data with another computer, by using a protocol such as TCP/IP. When the device **1050** is connected through a dial-up, the communication section **1052** performs the transmission/reception of data with the relay device **1030** through the public telephone line network **1004**.

The control signal reception section **1053** receives the control signal **1063** transmitted from the control signal transmission section **1032**. When the identification information of its own device is identical to the device identification information included in the transmitted control signal **1063**, the control signal reception section **1053** determines that this control signal **1063** is the signal for its own device, and performs the reception processing of this control signal **1063**.

The PPP connection section **1054** is the processing section for making the demand for the dial-up connection and the establishment of the PPP session, to the relay device **1030**. When the control signal **1063** identical to the identification information of its own device is received from the relay device **1030**, the device **1050** makes the demand for the dial-up connection and establishment of the PPP session, to the relay device **1030**.

The processing sequence of the remote diagnosis system as described above will be explained. FIGS. **9** and **10** are views illustrating the processing sequence among the communication terminal **1010**, the relay device **1030**, and the device **1050**. FIG. **9** illustrates the processing sequence when the batch mode is designated by the communication terminal **1010** as the reply mode. FIG. **10** is the processing sequence when the interactive mode is designated by the communication terminal **1010** as the reply mode.

The processing sequence at the time of the batch mode in FIG. **9** will be described first. First, the operator operates the communication terminal **1010**, and gives an instruction to start the inspection. Specifically, the operator operates the operation section **1013** and performs the operation for designating a device **1050**, or an inspection target, and the operation for designating an inspection item. In response to these operations, the inspection instruction file preparation section **1011** prepares the inspection instruction file **1061**. In addition, when the inspection item is designated, a reply mode is set in accordance with this inspection item. Alternately, the operator may designate the reply mode expressly. Further, the inspection start request section **1016** transmits a UDP packet to the designated device **1050** (step S**1101**).

As described above, the inspection start request section **1016** can acquire the IP address of the device **1050**, or the transmission destination, by referring to the inspection instruction file **1061**, and therefore the UDP packet is sent to this IP address. In addition, the inspection start request section **1016** designates the port number of the standby TCP port in the UDP packet. The previously defined number may be used as the port number of the standby TCP port.

The inspection start request section **1016** sends the UDP packet a plurality of times at a prescribed interval such as one second interval. After the UDP packet is sent a prescribed number of times by the inspection start request section **1016**, the communication terminal **1010** starts timing by a timer, and transmits to the standby status for the TCP connection.

Next, the UDP packet sent from the communication terminal **1010** is intermediately received by the relay device **1030**. Then, the relay device **1030** transmits the control signal **1063** to the device **50** corresponding to the IP address of the transmission destination of the UDP packet (step S**1102**). The relay device **1030** acquires the IP address of the transmission destination from the UDP packet, and by referring to the device database **1034**, the relay device **1030** can specify the device **1050** to which the IP address is assigned. Moreover, by referring to the device database **1034**, the relay device **1030** can obtain the device identification information of the device **1050**. Then, the relay device **1030** transmits to each device **1050** the control signal **1063** designating the device identification information, by using a particular frequency band. Here, the relay device **1030** is adapted to include the information of the IP address and the port number of the communication terminal **1010**, or the transmission source.

Next, the device **1050** having the device identification number identical to the designated device identification number receives the control signal **1063**. Then, the device **1050** acquires the IP address and the port number of the communication terminal **1010**, or the transmission source, from the received control signal **1063** (step S**1103**).

Next, the PPP connection section **1054** performs the establishment processing of the dial-up line network by originating a call for dial-up. The PPP connection section **1033** of the relay device **1030** responds to this call and the dial-up line network is established (step S**1104**). Further, when the PPP connection section **1054** makes a demand for establishment of a PPP session, the PPP session is established between the device **1050** and the relay device **1030** (step S**1105**).

When the PPP session is established, subsequently, the communication section **1052** of the device **1050** makes a demand for a TCP connection, to the communication section **1012** of the communication terminal **1010**. In step S**1103**, since the communication section **1052** acquires the IP address and the port number of the communication terminal **1010**, the communication section **1052** makes the TCP connection demand targeting the IP address and the port number. Then, a three-way handshake is performed (step S**1106**), and the TCP connection is established between the device **1050** and the communication terminal **1010**.

In this way, the remote diagnosis system according to this embodiment establishes the PPP session from the device **1050** that receives the connection demand by the UDP packet, and subsequently the same device **1050** establishes the TCP connection. Therefore, at the point in time when the PPP session is established, the TCP connection can be established instantly.

When the TCP connection is established between the device **1050** and the communication terminal **1010**, the inspection instruction file preparation section **1011** sets reply mode information in the header of the inspection instruction file **1061**. Here, the batch mode is designated (step S**1107**). The inspection instruction file **1061** is transmitted to the device **1050** via the relay device **1030** (step S**1108**).

When the inspection instruction file **1061** is received, the device **1050** acquires the reply mode information from the header of the inspection instruction file **1061**. Here, since the batch mode is designated, the device **1050** transmits a TCP disconnection demand to the communication terminal **1010**. Then, a three-way handshake is performed, and the TCP connection between the device **1050** and the communication terminal **1010** is disconnected (step S**1109**).

When the TCP connection between the device **1050** and the communication terminal **1010** is disconnected, the PPP connection section **1054** performs a disconnection processing of the PPP session with the PPP connection section **1033** (step S**1110**), and performs the disconnection processing of the dial-up line network (step S**1111**). In this way, after receiving the inspection instruction file **1061**, the device **1050** disconnects the TCP connection and the dial-up connection once.

Next, the device **1050** analyzes the content of the inspection instruction file **1061** (step S**1112**). Namely, the device **1050** analyzes the content of the inspection instruction item or the inspection instruction command. Then, the device **1050** conducts the inspection in accordance with the inspection item or the inspection instruction command written in the inspection instruction file **1061**. For example, the number of rotations of the motor of the device **1050**, the device temperature of the device **1050**, and the remaining memory capacity of the device **1050**, etc. are measured. Then, the device **1050** prepares the inspection result file **1062** in which the result of the conducted inspection is recorded (step S**1113**).

When the transmission of the inspection result file **1062** is prepared, the device **1050** performs the establishment of the TCP connection with the communication terminal **1010** again. Specifically, when the inspection result file **1062** is prepared, the PPP connection demand section **1054** originates a call for a dial-up again and establishes the dial-up line network (step S**1114**), and further the PPP session is established between the device **1050** and the relay device **1030** (step S**1115**). Namely, after preparing the inspection result file **1062**, the device **1050** makes the dial-up connection by originating the call for dial-up on its own, without receiving the control signal **1063**.

Subsequently, the device **1050** makes a TCP connection demand to the communication terminal **1010**, performs a three-way handshake, and establishes the TCP connection (step S**1116**). In this way, when a new TCP connection is established, the device **1050** transmits the inspection result file **1062** to the communication terminal **1010** using the newly established TCP connection (step S**1117**). In the communication terminal **1010**, when the inspection result file **1062** is received, the inspection result is displayed on the monitor **1014**.

After transmitting the inspection result file **1062**, the device **1050** makes a TCP disconnection demand to the communication terminal **1010**. Then, a three-way handshake is performed and the TCP connection is disconnected (step S**1118**).

When the TCP connection between the device **1050** and the communication terminal **1010** is disconnected, the PPP connection section **1054** performs the disconnection processing of the PPP session with the PPP connection section **1033** (step S**1119**), and performs the disconnection processing of the dial-up line network (step S**1120**). In this way, after the inspection result file **1062** is transmitted, the TCP connection is disconnected, and further the dial-up connection is disconnected. As to the inspection item for which a long processing time is required, by using the batch mode, it is thus possible to obviate the problem such as a disconnection of the line during the communication, and the processing can be finished under a normal condition.

Subsequently, the processing sequence of the interactive mode will be described with reference to FIG. **10**. In FIG. **10**, steps S**1201** to S**1206** are the same as the steps S**1101** to S**1106** as shown in FIG. **9**. Namely, by performing the steps S**1201** to S**1206**, the TCP connection is established between the device **1050** and the communication terminal **1010**.

Next, the inspection instruction file preparation section **1011** sets the reply mode information in the inspection instruction file **1061**. Here, the interactive mode is designated (step S**1207**). The inspection instruction file **1061** is transmitted to the device **1050** via the relay device **1030** (step S**1208**).

When the inspection instruction file **1061** is received, the device **1050** acquires the reply mode information from the header of the inspection instruction file **1061**. Here, since the interactive mode is designated, the device **1050** analyzes the content of the inspection instruction file **1061** while maintaining the TCP connection (step S**1209**), and conducts the inspection in accordance with the inspection item or the inspection instruction command written in the inspection instruction file **1061**. Then, the device **1050** prepares the inspection result file **1062** in which the result of the conducted inspection is recorded (step S**1210**).

When the inspection result file **1062** is prepared, the device **1050** transmits the inspection result file **1062** to the communication terminal **1010** while maintaining the already established TCP connection (step S**1211**). Namely, the TCP connection used for receiving the inspection instruction file **1061** is maintained as it is, whereupon the inspection result file **1062** is transmitted. In the communication terminal **1010**, when the inspection result file **1062** is received, the inspection result is displayed on the monitor **1014**. Thus, as to the inspection item for which a short processing time is required, by using the interactive mode, the response can be obtained in a short time with the TCP connection maintained.

After the inspection result file **1062** is transmitted, the device **1050** makes a TCP disconnection demand to the communication terminal **1010**. Then, a three-way handshake is performed, and the TCP connection is disconnected (step S**1212**). Further, the PPP session disconnection processing is performed (step S**1213**), and the disconnection processing of the dial-up line network is performed (step S**1120**). In this way, after the inspection result file **1062** is transmitted, the TCP connection is disconnected, and further the dial-up is disconnected.

Hitherto, the processing sequence of the entire remote diagnosis system including the communication terminal **1010**, the relay device **1030**, and the device **1050** has been described. Next, the communication terminal **1010** is focused, and the flow of the remote diagnosis processing on the device **1050** will be described. FIGS. **11** and **12** are flowcharts of the remote diagnosis processing in the communication terminal **1010**.

In the previous stage, the inspection instruction file **1061** is prepared through the operation of the operator. The inspection instruction file preparation section **1011** refers to the device database **1015**, acquires the IP address of the device **1050**, or the diagnosis target, designated by the operator, and writes this IP address in the inspection instruction file **1061**.

In this state, first, the inspection start request section **1016** checks whether or not the inspection instruction file **1061** is prepared (step S**1301**), and when it is prepared, reads the IP address of the transmission destination, or the diagnosis target, from the inspection instruction file **1061** (step S**1302**).

Next, the reply mode is determined from the inspection item registered in the inspection instruction file **1061**, which is then recorded in a configuration memory, etc. (step S**1303**). The communication terminal **1010** includes a condition set file in which each inspection item and the reply mode (the batch mode or the interactive mode) are corresponded, and in accordance with this condition set file, the reply mode is determined. For example, the batch mode is corresponded to the inspection item of which a time is required for the inspection. Alternately, the mode may be explicitly selected by the operator. Namely, the reply mode may be automatically set from the inspection item, etc., or the reply mode may be set by a manual operation of the operator.

Next, the inspection start request section **1016** acquires the information on the number of UDP transmissions and the interval of UDP transmissions from the UDP transmission definition file (step S**1304**) stored in the storage section not shown, and in accordance with this information, transmits the UDP packet targeting the IP address acquired in step S**1302** (step S**1305**). For example, the UDP packet is transmitted five times at one-second intervals.

After the UDP packet is transmitted a predetermined number of times, the communication terminal **1010** opens a standby port for the TCP connection (here, as shown in the figure, port number is defined as N.), and transmits to the standby status for the TCP connection demand (step S**1306**). Thus, it is so prepared that the TCP connection can be established instantly at the point in time when the TCP connection demand is generated from the device **1050**.

Then, when the TCP connection demand is not received (NO in step S**1307**), timing by a timer is started (step S**1308**), and the TCP connection demand is monitored until a prescribed time elapses (step S**1309**). Then, when the TCP connection demand is not received after a prescribed time elapsed, the transmission error processing of the inspection instruction file **1061** is performed (step S**1310**). For example, the message reading "transmission of the inspection instruction file is failed" is displayed on the monitor **1014**.

When the TCP connection demand is received in step S**1307**, mode designation is performed to the inspection instruction file **1061** after the TCP connection is established (step S**1311**). Namely, the information on the reply mode set in step S**1303** is written in the header of the inspection instruction file **1061**. Then, the inspection instruction file **1061** is transmitted to the device **1050** (step S**1312**). After the inspection instruction file **1061** is transmitted, the communication terminal **1010** transmits to a standby status as to whether or not the data is received (step S**1314**). When the interactive mode is set as the reply mode (YES in step S**1313**), and when the data is not received, the timing of the timer is started (step S**1315**), and the standby status for receiving data is kept until a prescribed time elapses (step S**1316**). Then, when the data is not received even if the prescribed time elapsed, there is a possibility that the interactive mode is switched to the batch mode on the side of the device **1050**, although the interactive mode is designated. Therefore, the processing is moved to the batch mode of FIG. **12**.

When the data is received in step S**1314**, the reception processing of the inspection result file **1062** is performed (step S**1318**). Namely, the reception processing of the inspection result file **1062** returned from the device **1050** is performed. Next, the disconnection processing of the TCP connection is performed (step S**1319**). The content of the inspection result recorded in the received inspection result file **1062** is displayed on the monitor **1014**, for example. In this way, the communication terminal **1010** can obtain the inspection result.

When the batch mode is designated as the reply mode (NO in step S**1313**), the disconnection demand from the device **1050** is received, and the TCP connection is disconnected (step S**1320**). Thus, the processing is moved to step S**1321** of FIG. **12**. Alternately, when the TCP disconnection demand is received from the device **1050** in the step not shown after a prescribed time elapsed in step S**1316** of FIG. **11** (changed from the interactive mode to the batch mode), the TCP connection is disconnected and thereafter, the processing is moved to step S**1321** of FIG. **12**.

Subsequently, the flowchart of the processing related to the batch mode of FIG. **12** will be described. The communication terminal **1010** transmits to the standby status for the TCP connection by using the port number obtained by adding 1 to the TCP port number at the time of transmitting the inspection instruction file **1061** (step S**1321**). Namely, in step S**1306**, the standby status is set by using the port number N. However, here, the TCP port of the port number N+1 is opened and the communication terminal **1010** is set in the standby status. The rule of adding 1 to the port number in the batch mode is previously defined with the device **1050**, and is written in the configuration file, etc.

Then, the TCP connection demand from the device **1050** is awaited (step S**1322**), and when the TCP connection demand is not received, the timing by the timer is started (step S**1323**). Then, when the connection demand is not received until a prescribed time elapsed (YES in step S**1324**), the transmission error processing of the inspection instruction file **1061** is performed (step S**1325**). For example, the message reading "transmission of the inspection instruction file is failed" is displayed on the monitor **1014**.

When the TCP connection demand is received in step S**1322**, the reception processing of the inspection result file **1062** is performed (step S**1326**). Namely, the reception processing of the inspection result file **1062** returned from the device **1050** is performed. Next, the disconnection processing of the TCP connection is performed (step S**1327**). The content of the inspection result recorded in the received inspection result file **1062** is displayed on the monitor **1014**, for example. In this way, the communication terminal **1010** can obtain the inspection result.

FIGS. **13** and **14** are processing flowcharts of the remote diagnosis focusing on the device **1050**. The device **1050** is set in the standby status for receiving the control signal **1063** from the relay device **1030** (step S**1401**). When the control signal **1063** is received, the device **1050** checks whether or not the IP address and the port number are included in the control signal **1063** (step S**1402**). This IP address is the IP address of the communication terminal **1010**, or the transmission source of the inspection instruction file **1061**, and the port number is the number of the port at which the communication terminal **1010** stands by for the TCP connection demand (in this example, the port number is N). When the IP address and the port number are not included, this is a control signal for another processing. Therefore, the another processing (not shown) is performed, and the standby status for receiving the control signal **1063** is set again.

When the IP address and the port number are included in the control signal **1063**, the PPP connection section **1054** originates the call for dial-up to the PPP connection section **1033** of the relay device **1030**, and the dial-up line network is established (step S**1403**). Then, the PPP session is established on the dial-up connection (step S**1404**).

Subsequently, the communication section **1052** makes the TCP connection demand to the communication terminal **1010**, by using the IP address and the port number (port number N) acquired in step S**1302** (STEP S**1405**). Then, the establishment of the TCP connection is awaited (step S**1406**), and when the TCP connection is established, the communication section **1052** performs the reception processing of the inspection instruction file **1061** (step S**1407**). The device **1050** acquires the information on the reply mode from the header of the received inspection instruction file **1061**, and determines the reply mode (step S**1408**).

When the interactive mode is designated as the reply mode (YES in step S**1408**), the inspection item or the inspection instruction command written in the inspection instruction file **1061** is analyzed (step S**1409**), and the inspection is conducted in accordance with the inspection item or the inspection instruction command thus obtained. After the inspection is conducted, preparation of the inspection result file **1062**, in which the inspection result is written, is started. Then, whether or not the preparation of the inspection result file **1062** is completed is checked (step S**1410**).

When the preparation of the inspection result file **1062** is not completed, the timing of the timer is started (step S**1414**), and the completion of the inspection result file **1062** is awaited until a prescribed time elapses (step S**1415**). When the inspection result file **1062** is not completed even if the prescribed time elapsed, the processing is moved to the step of FIG. **14**. Namely, the processing is moved to the batch mode because much time is consumed for conducting the inspection, although the interactive mode is designated.

When the preparation of the inspection result file **1062** is successfully completed (YES in step S**1410**), the inspection result file **1062** is transmitted to the communication terminal **1010** (step S**1411**). Namely, the inspection result file **1062** is returned, while maintaining the TCP connection used in the transfer of the inspection instruction file **1061** as it is.

When the transmission of the inspection result file **1062** is finished, the disconnection processing of the TCP connection is performed (step S**1412**). Then, the disconnection processing of the PPP session is performed and finally the disconnection of the dial-up line network is performed (step S**1413**).

When the reply mode is determined to be the batch mode in step S**1408** (namely, when the batch mode is designated from the communication terminal **1010**), or when a prescribed time elapsed in step S**1415** (namely, although the interactive mode is designated from the communication terminal **1010**, much time is consumed in the inspection), the processing is moved to the batch mode of FIG. **14**.

First, the device **1050** makes the demand for the TCP disconnection to the communication terminal **1010**, and performs the disconnection processing of the TCP connection (step S**1416**), and subsequently, disconnects the PPP session and disconnects the dial-up line (step S**1417**).

The device **1050** analyzes the content of the inspection instruction file **1061** in the state of disconnecting the line (step S**1418**), and conducts the inspection of the inspection item in accordance with the content thus obtained. Then, the inspection result file **1062** is prepared (step S**1419**).

When the preparation of the inspection result file **1062** is completed and the transmission of the inspection result file **1062** is prepared, the device **1050** originates the call for dial-up to the relay device **1030** without waiting for the reception of the control signal **1063** and establishes the dial-up line (step S**1420**), and then establishes the PPP session (step S**1421**).

Then, by adding 1 to the TCP port number (port number N) used in receiving the inspection instruction file **1061**, thereby designating the TCP port of port number N+1 to transmit the TCP connection demand to the communication terminal **1010** (step S**1422**). As shown in step S**1321** of FIG. **12**, the communication terminal **1010** opens the TCP port of the port number N+1 and is set in the standby status. Thus, when the TCP connection is established (step S**1423**), the device **1050** transmits the inspection result file **1062** using this TCP connection (step S**1424**). After the file transmission is finished, the TCP disconnection is performed (step S**1425**), and the PPP session and the dial-up line are disconnected (step S**1426**).

In this way, according to the remote diagnosis system of this embodiment, when the inspection is started, the UDP packet is sent from the communication terminal **1010** on the side of transmitting the inspection instruction file **1061**. Then, the communication terminal **1010** that transmitted the UDP packet is set in the standby status for the TCP connection. And then, demands for the connection of the dial-up line and the TCP connection are made from the device **1050** that has received the control signal **1063** transmitted based on the UDP packet. Accordingly, at the point in time when the device **1050** establishes the line network by the dial-up connection, the TCP connection can be established instantly.

In addition, the communication terminal **1010** designates whether or not the inspection result file **1062** is received while maintaining the TCP connection as it is at the time of transmitting the inspection instruction file **1061**, or whether or not another TCP connection is newly established and the inspection result file is received after disconnecting the line network once. Thus, when much time is required for conducting the inspection or preparing the inspection result file **1062**, it is possible to obviate the problem that the communication is disconnected in the middle of processing.

Namely, in a case of the non-continuous connection such as the dial-up connection between the device **1050** and the relay device **1030** as in this embodiment, when the transmission/reception of data is not detected for a prescribed time, the line network is sometimes disconnected. When such a line abnormality occurs in the state where the communication terminal **1010** is set in a standby status for the reception of the inspection result file **1062**, recovery processing thereof becomes complicated. Therefore, the inspection requiring much time is previously defined, and the batch mode is applied to the inspection instruction including such an inspection item. Thus, after the inspection instruction file **1061** is received, the device **1050** disconnects the line and establishes the line again when the transmission of the inspection result file **1062** is prepared. Accordingly, it is possible to prevent the occurrence of a line abnormality error in the middle of a series of processing.

Hitherto, the second embodiment of the present invention has been described. However, the connection between the relay device **1030** and the device **1050** is not limited to the telephone line but may be a wireless network. Namely, the present invention can generally be applied to the network in which the connection between the device **1050** and the relay device **1030** is the non-continuous connection and the line can be established only from the device **1050**. In addition, under the condition that the connection between the communication terminal **1010** and the relay device **1030** is the continuous connection, an exclusive line can also be used in addition to the Internet.

While the present invention has been described with respect to preferred embodiments thereof, it will be apparent to those skilled in the art that the disclosed invention may be modified in numerous ways and may assume many embodiments other than those specifically set out and described above. Accordingly, it is intended by the appended claims are intended to cover all modifications of the present invention that fall within the true spirit and scope of the present invention.

What is claimed is:

1. A remote diagnosis system comprising:

a control device;

a relay device which is continuously connected to said control device; and

an inspection target device which is connected to said relay device by a communication network established by a connection demand from the inspection target device, wherein

said control device includes a unit for transmitting a UDP (User Datagram Protocol) packet to said inspection target device,

said relay device includes a unit for transmitting a control signal to said inspection target device when said UDP packet transmitted from said control device is received,

said inspection target device includes a unit for establishing said communication network by making the connection demand to said relay device and transmitting a TCP (Transmission Control Protocol) connection demand to said control device, when said control signal is received, and

by the TCP connection demand from said inspection target device, a TCP connection is established between said control device and said inspection target device, and thereafter said control device transmits an inspection instruction file to said inspection target device by using this TCP connection.

2. The remote diagnosis system according to claim **1**, wherein said inspection target device that received said inspection instruction file conducts an inspection in accordance with said inspection instruction file, and thereafter transmits an inspection result file to said control device by using the TCP connection used for transmitting said inspection instruction file.

3. The remote diagnosis system according to claim **1**, wherein said control device repeatedly transmits the UDP packet to said inspection target device a prescribed number of times.

4. The remote diagnosis system according to claim **2**, wherein said control device repeatedly transmits the UDP packet to said inspection target device a prescribed number of times.

5. The remote diagnosis system according to claim **3**, wherein said control device transits to a standby status for a TCP connection from said inspection target device after the UDP packet is transmitted a prescribed number of times.

6. The remote diagnosis system according to claim **4**, wherein said control device transits to a standby status for a TCP connection from said inspection target device after the UDP packet is transmitted a prescribed number of times.

7. A communication system comprising:

a first communication device;

a relay device which is continuously connected to said first communication device; and

a second communication device which is connected to said relay device by a communication network established by a connection demand from the second communication device, wherein

said second communication device includes a unit for establishing the communication network by making the connection demand to said relay device and transmitting a TCP (Transmission Control Protocol) connection demand to said first communication device,

said first communication device includes a unit for establishing a TCP connection with said second communication device by the TCP connection demand from said second communication device and transmitting a transmission file to said second communication device by designating a reply mode, and

said second communication device transmits a reply file while maintaining the TCP connection used in receiving the transmission file when a first mode is designated as the reply mode, and when a second mode is designated, disconnects the communication network with said relay device, and after a communication network with said relay device is established again, establishes a new TCP connection and transmits the reply file.

8. The communication system according to claim **7**, wherein said second communication device establishes the communication network again when transmission of the reply file is prepared, after the communication network with said relay device is disconnected.

9. The communication system according to claim **7**, wherein said second communication device disconnects the communication network with said relay device when it is determined that, even when said first mode is designated as the reply mode, time required for reply processing of the reply file corresponds to a prescribed condition, and after the communication network with said relay device is established again, establishes a new TCP connection and transmits the reply file.

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